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SIXTH ANNUAL REPORT

OF THE

BOARD OF CONTROL

OF THE

NEW YORK

Agricultural Experiment Station,

(GENEVA, ONTARIO CO.)

FOR THE YEAR 1887,

WITH REPORTS OF THE DIRECTOR AND OFFICERS.

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STATE OF NEW YORK.

No. 36.

IN ASSEMBLY,

JANUARY, 1888.

REPORT

OF THE

BOARD OF CONTROL OF THE NEW YORK AGRICULTURAL EXPERIMENT STATION.

To the Honorable the Legislature of the State of New York:

I herewith respectfully submit, in behalf of the Board of Control, the Sixth Annual Report of the New York Agricultural Experiment Station. Its contents will explain the success which is now rewarding our efforts; and this, with the report of the Treasurer, renders unnecessary any extended remarks on my part.

Respectfully submitted.

JAMES McCANN,
President.

45755

1887.

ORGANIZATION OF THE STATION.

BOARD OF CONTROL.

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JAMES McCANN, President	*Elmira, Chemung county.*
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STATION OFFICERS.

E. Lewis Sturtevant, A. M., M. D.	*Director.*
C. S. Plumb, B. S.*	*First Assistant.*
Emmett S. Goff	*Horticulturist.*
M. H. Beckwith	*Assistant Horticulturist.*
J. C. Arthur, D. Sc.†	*Botanist.*
S. Moulton Babcock, A. M., Ph. D.‡	*Chemist.*
E. F. Ladd, B. S	*Assistant Chemist.*
F. E. Newton	*Stenographer.*
G. W. Churchill	*Farmer.*

Post-office address: Geneva, Ontario Co., N. Y.

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[*] Resigned October first to accept professorship at University of Tennessee.

[†] Resigned September first to accept professorship at Purdue University.

[‡] Resigned December first to accept professorship at University of Wisconsin.

TREASURER'S REPORT.

GENEVA, N. Y., *October* 1, 1887.

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To the Board of Control of the New York Agricultural Experiment Station:

As Treasurer of the Board of Control, I do respectfully report:

That I have received from the Treasurer of the State of New York for the twelve months ending September 30, 1887	$20,000 00
That the balance on hand October 1, 1886, was	738 56
Total	$20,738 56

And I do further report that I have expended during the twelve months ending September 30, 1887, the sum of $19,428.75, vouchers for which, duly audited by the Special Auditing Committee of the Board of Control, have been furnished the Comptroller of the State of New York.

Properly classified, the expenditure has been as follows:

Board of Control	$714 30
Farm implements and tools	169 82
Furniture	1,231 19
Freight, cartage and express	145 14
Fuel	281 33
Labor	2,796 01
Laboratory department	396 03
Library	73 69
Meteorological department	6 30
Permanent improvement	1,379 00
Postage expenses	115 00
Printing	863 68
Repairs	290 85
Salaries	9,487 02
Scientific apparatus	19 27
Carried forward	$17,968 63

Brought forward	$17,968 63
Stationery	76 25
Sundries	68 63
Supplies	926 60
Travel	388 64
Total expenditures	$19,428 75
Balance on hand	1,309 81
Total	$20,738 56

And I do further report that I have received from sales the sum of $136.25, which sum has been duly paid to the Treasurer of the State of New York.

WM. O'HANLON,
Treasurer.

REPORT OF THE DIRECTOR.[*]

To the Board of Control of the New York Agricultural Experiment Station:

GENTLEMEN.—I herewith submit my sixth annual report for the calendar year 1887.

The year has been one of climatic extremes, May, June and July being much warmer than usual, the mean assumed to be that for the twelve years average published by Prof. Wilson, of Hobart College, Geneva, in 1867, and summarized in the second annual report of this station.

The following tabulation of the mean monthly temperatures for 1885, 1886 and 1887 will be found of interest, the results being those of the 7 A. M., noon, and twice the 6 P. M. readings, divided by four:

	1885.	1886.	1887.	Mean for 12 years.[†]
January	21.05°	20.58°	21.60°	25.29°
February	14.23	23.22	25.42	25.39
March	21.15	32.37	27.65	32.26
April	43.78	50.40	43.85	43.21
May	58.03	58.45	65.80	55.66
June	66.93	67.95	69.22	64.93
July	72.91	71.47	78.00	70.28
August	65.98	69.70	68.92	68.08
September	60.65	63.60	59.55	60.47
October	49.04	51.07	46.11	49.66
November	39.90	37.17	37.3	39.12
December	28.89	22.85	....	25.56
	45.21	47.40	....	46.66

The number of days upon which rain or snow was noted or recorded was for the various years:

	1882.	1883.	1884.	1885.	1886.	1887.
January	....	13	11	12	12	12
February	....	13	14	7	11	15
March	....	12	16	8	11	10
April	....	11	11	13	10	9
May	....	16	15	13	7	7
June	9	12	10	12	7	9
July	12	13	12	9	12	10
August	10	9	6	20	6	7
September	6	10	7	6	11	5
October	7	10	13	12	9	15
November	7	5	8	15	11	9
December	4	11	10	12	13	......
Total	....	135	137	139	120	......

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[*] E. Lewis Sturtevant, A. M., M. D.

[†] Hobart College figures.

The figures in this table differ slightly from those heretofore given in our reports, as the rainfalls, too slight for record, are here included.

The rainfall recorded for the several years is as below, in inches:

	1882.	1883.	1884.	1885.	1886.	1887.	Twelve years aver'ge.*
January	....	0.48	1.83	1.07	1.13	0.18	1.59
February	....	1.44	2.01	0.61	0.95	2.97	1.14
March	....	0.88	2.54	0.12	1.13	0.48	1.89
April	....	1.58	0.83	1.26	4.13	1.37	3.37
May	....	4.45	2.49	1.58	1.92	0.46	2.93
June	3.69	4.12	2.01	2.49	2.92	2.01	2.12
July	2.42	2.98	2.33	4.64	4.41	6.37	3.28
August	2.37	3.47	1.44	5.02	2.86	3.03	3.69
September	1.25	2.12	3.17	2.11	2.31	0.75	2.50
October	0.62	2.10	1.67	2.88	1.39	1.74	2.12
November	1.22	1.54	1.01	1.36	3.48	1.58	2.25
December	0.55	0.73	0.97	0.76	1.24	......	2.03
	....	25.89	22.30	23.90	27.87	......	29.91

The Hobart College observations were taken on a lower level, and about a mile and a half from the station.

The total rainfall recorded each year for the planting and preceding season, or from January to May; for the growing season, or from June to September, is as below:

	1883.	1884.	1885.	1886.	1887.
January to May — Total rainfall (inches)	8.83	9.70	4.64	9.26	5.46
January to September — Total rainfall (inches)	12.69	8.95	14.26	12.50	12.16

The present season showed a spring drought which was far more excessive than these figures indicate, produced not alone from the deficiency of the rainfall, but from the great evaporation consequent upon high temperature and frequent winds. The following summaries of rainfall for May, June and July bring the deficiency in rain more fully to our attention than do the summaries:

	Rainfall.	
May 6	.02	inches
7	.02	"
18	†.00	"
24	.15	"
25	.10	"
26	.15	"
28	.02	"
June 1	.40	"

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* Hobart College figures.

† Not sufficient to gauge.

	Rainfall.
June 2	.33 inches.
6	.03 "
17	.04 "
18	.40 "
19	.20 "
21	.21 "
22	.31 "
24	.09 "
July 6	.18 "
9	.53 "
10	*.00 "
15	†.00 "
16	.05 "
17	.15 "
18	.53 "
21	‡2.64 "
22	1.23 "
25	1.06 "

The temperature summary for the year is given below:

MONTHS.	Greatest heat.	Greatest cold.	Mean of maxi'm temp.	Mean of mini'm temp.	Mean monthly temp.
January	50.7°	—8.°	30.2°	10.0°	21.6°
February	54.2	1.	31.7	15.4	25.4
March	51.7	8.7	33.1	19.4	27.6
April	69.5	17.2	51.6	32.1	43.8
May	88.2	37.5	74.1	50.7	65.8
June	89.2	47.7	75.5	55.9	69.2
July	98.0	58.7	85.3	65.4	78.0
August	88.5	46.0	76.0	57.0	68.9
September	81.7	37.2	67.6	47.8	59.6
October	78.5	21.2	56.2	38.0	46.1
November	67.5	15.0	46.6	28.6	37.3
December	....	....	....	....	....

The amount of bright sunlight recorded is as follows, in hours and per cent of possible, for each month. The apparatus had its position changed on September 9, and failed to work satisfactorily in its new quarters. Hence the records for the year cease at this date:

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* Not gaugeable.

† In two hours.

MONTHS.	1887. Hours.	1887. Per cent. of possible.	1886. Per cent. of possible.	1885. Per cent. of possible.
January	44.00	14.5	14.3	....
February	61.50	18.2	26.7	....
March	110.76	29.7	22.3	....
April	159.00	39.9	36.3	....
May	265.00	58.4	51.9	36.4
June	217.75	47.6	55.2	52.0
July	267.50	57.9	52.6	53.8
August	235.75	55.0	56.0	38.1
September, eight days	43.50	......	......	....
September	......	......	53.7	55.3
October	......	......	41.8	39.3
November	......	......	34.8	18.1
December	......	......	24.2	17.6
The average for June, July and August, the three growing months	....	53.5	54.6	48.0

The complex set of conditions comprehended within the term climate does not enable us to assign relationship between the amount of crop and any one factor; hence sums of temperature required for the development of any given crop cannot have uniformity under varied conditions as regarding moisture and probably sunlight. For the purpose of illustrating this point, some Philadelphia Extra Early Peas have been planted at intervals during the season, with the following result:

No.	Planted.	Vegetated.	First bloom.	First edible.	First ripe.	Weight of 100 dry peas.
1	April 20	May 4	May 25	June 10	June 23	26.7 grams.
2	May 4	May 18	June 23	July 1	July 16	25.5 grams.
3	May 18	June 3	June 23	July 1	July 23	24.2 grams.
4	June 3	June 10	July 1	July 13	July 28	25.5 grams.
5	June 15	June 23	July 16	July 28	Aug. 10	21.2 grams.
6	July 1	July 13	Aug. 2	Aug. 10	Sept. 29	20.1 grams.
7	July 14	July 21	Aug. 5	Sept. 14	Oct. 3	20.8 grams.
8	Aug. 2	Aug. 10	Sept. 2	Sept. 27	....	....
9	Aug. 17	Aug. 23	Sept. 21	....	....	....

NUMBER.	Days from planting to vegetation.	From vegetation to bloom.	From bloom to edible.	From edible to ripe.	From vegetation to ripeness.
1	14	21	16	13	50
2	14	36	9	15	50
3	16	20	9	22	51
4	7	21	12	15	48
5	8	23	12	13	48
6	12	20	8	50	78
7	7	15	40	19	74
8	8	23	25	......	....
9	6	29	......	......	....

On account of the difficulty of observation in matters of this kind, we may believe that there is error in No. 2 and No. 7, and hence these may be excluded from the comparisons.

The sums of temperature for the remainder are, hence :

NUMBER.	Planting to veg.	Veg. to bloom.	Bloom to edible.	Edible to ripe.	Veg. to ripen'ss.
1.	731°	1417°	1033°	914°	3364°
3.	1062	1389	577	1700	3666
4.	475	1491	956	1128	3575
5.	589	1761	900	981	3642
6.	956	1519	590	3109	5220
8.	590	1521	1469	....	....
9.	398	1871	....	....	....

When we consider the difficulty of determining the exact day when ripeness occurs, and the loss of the early pods sometimes from mildew, we must note the uniformity of the days and the temperatures from the period from vegetation to ripeness; yet if we divide the sums of temperature by the number of days, we have for the mean temperature required 67, 71, 76, 75, etc., certainly not uniformities. The influence of climate appears, however, to have some relationship with the weight of the ripe seed.

In investigations of this character, however, it will be remembered that a degree of temperature has not equal influence upon vegetation in all portions of its scale, as all below 32° are absolutely nil, and the value of the fortieth degree and the eightieth degree are manifestly unequal. There is, hence, a greater difference in the effect upon growth between the 67° and 71° and the 71° and 75° above given than their numerical differences. If we examine the tabular data, we note that in Nos. 6 and 8 the sums of temperatures from vegetation to bloom are practically the same, distributed over twenty days in the case of No. 6, and twenty-three days in the case of No. 8; yet, in the case of Nos. 3 and 5 we have the same twenty-one and twenty-three days, with a marked difference between the sums of temperatures. From these and other considerations which our data will readily suggest, we must conclude that this method of estimating climate through the observations of plants does not admit as yet of exactness of conclusion.

While difficult to express in tabular form, yet an inspection of the soil moisture during the various periods must convince that the amount of available water is certainly as determining a cause of plant development as increase of temperature alone.

The doctrine of phenology, or the estimation of climate by the first appearance of bloom, is an attractive one, but close observation may lead us to seriously question its adaptability for the purposes to which it has sometimes been applied. We have noticed that a succession of warm days often appears to influence the earliness of bloom more than do the sums of temperature over a more extended period. Thus the apple bloomed in May in the order 1886, 1887 and 1885, while the mean temperatures for April were 50°, 43° and 43°; for May were 58°, 65° and 58°. The following tables give the mean temperatures and the blooming of the various plants on the station grounds:

	MEAN TEMPERATURE.			
	March.	April.	May.	June.
Average of maximum, 1885	27.1°	50.7°	64.7°	74.1°
Average of maximum, 1886	37.0	60.1	65.7	75.1
Average of maximum, 1887	33.1	51.6	74.1	75.5
Average of minimum, 1885	10.3°	31.6°	44.0°	53.0°
Average of minimum, 1886	23.4	37.8	45.7	53.2
Average of minimum, 1887	19.4	32.1	50.7	55.9
Average mean, 1885	21.1°	43.8°	58.0°	66.9°
Average mean, 1886	32.4	50.4	58.4	68.0
Average mean, 1887	27.6	43.8	65.8	69.2

The date of development of several plants were:

	1885.	1886.	1887.
Cherry, first bloom	May 17.	April 26.	May 6.
Apple, first bloom	May 23.	May 6.	May 13.
Raspberry, first bloom	June 8.	May 29.	June 1.
Grape, first bloom	June 19.	June 14.	June 8.
Strawberry, first ripe	June 20.	June 9.	June 7.
Pea, first edible	June 20.	June 11.	June 10.

These figures are, however, of little interest for this discussion, and yet are worthy of presentation for future use, if only to call attention to the necessity of meteorological work as a preliminary to attempts at field work. Too much of our experimental work has been of little service on account of our not understanding sufficiently well the fundamental conditions under which growth and development have taken place. The statement may, however, concern us, that variation in crop from the influence classed under climatic may be greater than that which arises from ordinary omissions or applications of fertilizing elements, and I most seriously believe that through a proper understanding of climatic factors and physical relations thereof, we may conquer the power to influence physical conditions, so as to largely modify unfavoring climatic conditions. This conclusion may find illustration in a short presentation of the subject of intercultural tillage.

INTRODUCTORY.

After six years of station work the time has not yet arrived for me to attempt generalization which shall embrace the whole field of agriculture, despite the temptation. I feel as yet we have not sufficient definite knowledge, and I prefer rather the acquisition of fragmentary work than that of attempting to go further than the facts observed will bear out. I may be allowed, however, to indicate a line of thought which is in harmony with facts thus far observed, and which seem in a line of correct reasoning.

The most potent factor in the production of crop is that of soil moisture, for without the necessary supply of water soil fertility becomes unavailable. The presence of water renders plant growth possible. The presence of water under the proper conditions renders soil fertility available to the plant, and under favoring climatic conditions insures full development to plant growth. To control the water of the soil, even to some extent, is to the farmer a matter of great consequence. Indeed, as a fact of observation, the local condition of the soil as regards moisture seems to account, to a far greater extent than does fertility, for the variations which are so commonly to be observed between plants growing on the same plat and under otherwise like conditions, and to one who has carefully and experimentally studied the problem of plat experimentation, the issue becomes at once made and the question is forced into prominence of whether the true problem of crop raising should not be expressed by the question how to get the fertility of the soil into crop rather than how to apply fertility to the soil.

This line of reasoning, based upon the physical properties of the soil, suggests a division of farming into two prominent propositions: 1. That the present farming should derive its profits from the fertility mined from the soil. 2. That the use of fertilizers is essential for the maintenance and improvement of the condition of our land. The corollary to these is the seeming radical conclusion that fertilizers in practical farming should not be depended upon for an immediate result in crop, but rather from the general increase of crop concurrent with successive years of farming.

In order to illustrate this line of thought by a distinct example, I will make a short and incomplete study of the process known as "cultivation," based upon data accumulated by station work and supplemented by experimental observation.

CULTIVATION.

The effect of cultivation may be looked for in two directions. 1. The direct influence upon the plant through changes of habit induced by root pruning. 2. By its effect upon the root pasturage of the plant, induced by the physical changes produced thereby. This latter view is one to which I shall here give prominence.

The following propositions are justified by our accumulative data: The water of the soil may be considered from two points of view; one, water of percolation, the other, water of capillarity; the water of percolation meaning that which passes downward by gravity, the water of capillarity meaning the water which is held and distributed by capillary action. During the growing season, evaporation is in excess of the rainfall with reference to bare soil or with reference to transpiration from plant growth. Consequently the direction of movement of the soil water in this climate is upward rather than downward. The upward movement of the water being in excess of the downward movement during the growing season, the tendency of plant food is therefore toward the surface, and the water of the drainage does not necessarily represent the amount or character of the soil fertility available for crops. The water of the rainfall rarely penetrates to the drains, as it is not sufficient to saturate the soil above the drains. The drainage water is hence water of displacement, and its composition consequently becomes but a measure of the soluble salts which have escaped the upward movement.

Evaporation is a surface phenomenon. Any process which obstructs the outlet of capillary attraction to the surface, retards evaporation. This obstruction may be anything which breaks capillary connection, whether it be straw or manure in layers beneath the surface, or whether it be recently turned sod, or whether it be a mulch of fine particles upon the surface.

Cultivation, as the term is ordinarily understood, or intercultural tillage as it is preferably to be called, pulverizes the upper soil and, effecting a soil mulch, protects the capillary outlets from surface exposure, and thus conserves the water to the soil.

The extent of the conservation of water through the prevention of evaporation by cultivation, as measured by the lysimeters in 1885, from May to September inclusive, with the rainfall of 14.42 inches, as between bare soil and cultivated soil, was about 1.4 inches, and as between cultivated land and sod land about 2.25 inches. In other words, we may arrive at a just appreciation of the effect of the process of cultivation upon modifying the physical character of the soil by the assertion that by this means we increase the efficiency of the soil for water and have an increase of water, as expressed by equivalents to increased rainfall, of over ten per cent.; or yet otherwise expressed, the rainfall during these five months was about 1,629 tons to the acre; the gain from cultivation was a difference, as measured by the conservation of water, of over 158 tons, as against bare soil, and 250 tons as against sod land. We may express the fact for the whole year by saying that as an average for the years 1883 to 1886 inclusive (with an average rainfall of twenty-five inches), the average drainage from land in sod was 3.82 inches, from land left bare 8.15 inches, and from cultivated soil 10.03 inches, the difference between these figures representing the conservation of the water through the character of the surface.

These propositions offer quite secure ground for the explanation of the effects of intercultural tillage and for the formulating of practical directions for culture. We cannot doubt but that the process tends strongly to conserve moisture for the use of our crops, and that it may in itself determine whether, during seasons of drought, crops shall succeed or shall fail. We cannot doubt but that this process is to be explained through the prevention of the capillary interstices of the soil reaching the surface, and we must consistently believe that any process which tends to establish surface connection must tend toward the loss of water. This is a practical conclusion which can be readily verified. During the dry season of July let coarse manure be spaded into the soil in preparation of a strawberry bed, and then immediately set out the young strawberry plants. Unless timely rains intervene it will be found that these plants will perish from drought, as the coarse manure has broken the capillary connections and no supply of moisture can come from the lower areas. If, however, this land be thoroughly rolled with a heavy roller, by which contacts are established and connection with the lower soil furthered, capillary attraction will furnish a supply of water from below, and the plants will receive sufficient moisture for their growth.

The rational direction, therefore, to the farmer for carrying out intercultural tillages must be to use an implement as a means to an end, *i. e.*, the maintaining of a mulch of loose soil upon the field, the depth of this mulch to be determined by the character of the crop or by other circumstances. The timing of the process should not be arbitrary, but the intercultural tillage should be applied whenever the upper soil has regained, through the effect of rains, its connection with the lower soil and the capillary tubes become extended to the surface.

WEEDS.

In this same connection we may offer a few reflections concerning the weed problem. We will first take a few facts of experimental demonstration, as will be seen by an examination of our preceding reports.

1. That where weeds are allowed to grow freely the crops may be absolutely destroyed. In the case of corn the plants appear yellow, wilted, fail to attain proper size, and fail to form good ears, and the same phenomena may be noted with other crops.

2. The amount of fertility removed by weeds is not sufficient to establish the conclusion that the injury comes from the robbing of the soil and thus starving the plant. Furthermore, if such were the case, the application of additional manures to offset the robbery of the weeds would destroy their malign effect.

3. Weeds are not destructive through shading the ground, as experiment shows that mulches applied do not produce the same effect. If, however, we consider the enormous amount of water evaporated by these weeds during their growth, the necessity of additional water to the soil in an ordinary season during the hot months, and the appearance of the crop which indicates suffering from thirst, the conclusion becomes almost certain that the ill effect of weeds is largely due to their robbing the crop of proper moisture through their draughts upon the soil.

As interesting confirmatory evidence as to this being the true view of the weed question, we may quote the testimony of vineyardists, some of whom advocate allowing weeds to grow in their vineyards, while others advocate clean culture. Personal inquiry demonstrates the general fact that those gentlemen who advocate the leaving of weeds in their vineyards have lands which are not subject to excessive drought, while those who advocate clean culture have usually reported their soil as very permeable to water. When we consider that during the period of ripening of the wóod and of the berry in the grape, dryness is an important factor both in securing the ripening and in securing the qualities, we have at once a plausible explanation. Those gentlemen who advocate the allowing of weeds to grow are thus exhausting the surplus water of the soil injurious to their interests as vineyardists, while on the other hand those gentlemen who advocate the thorough removal of weeds are conserving the water to the soil which does not contain it in excess of the needs of their occupation.

WATER TABLE.

As evaporation during the growing season is in excess of the rainfall, it becomes evident that farming success is only possible from the existence of a stored water supply within the soil from the surplus of the season, when evaporation is somewhat checked, or from the waters accumulated from surface or saturated flow. This reserve of water has received the name of water table, and as is the case with our lakes and ponds, fluctuates in level. Unlike these, however, it is water distributed through soil, and may be called water of saturation, or in some cases, where bed rock is near the surface, water of capillarity, and is subject to exhaustion. This may be readily seen in wells, as we can observe the periodical increase or diminution, or even at times the disappearance of the water. This water table is hence of great consequence to the farmer, as furnishing the source of prevention or mitigation of droughts. When, however, this water table is too near the surface, we have present conditions unfavorable to the working of the land, and to plant growth, for agricultural plants cannot thrive with their roots in stagnant water. We may hence say of this water table as we do of fire, that it is a good servant but a bad master.

DRAINAGE.

This water table may be controlled through the process of draining. A series of tile drains furnish a succession of outlets which establish a line above which water of flow cannot pass. We hence have a depth of soil above the drain level which is freed from the washings of the water of the water table, and which is kept from the stagnation produced by the action of water in excess; it hence retains and increases its power of capillary action, and draws regularly through this capillarity from the stored waters, never abstracting in excess of the plant needs, and occasionally in proper soil and under proper conditions of soil treatment, never stinting the water supply to the plant. This ever upward movement of water, only intermittingly interrupted through percolating water of rainfalls, conserves soil fertility within itself, and even recovers soil fertility from the layers of soil subjected to the steeping of the reservoir water. These facts suggest a direction as to the depth at which drains should be placed. A drain should not be so deeply located as to carry the water table beyond the power of capillarity to freely convey to the surface, but should be as deeply laid as consistent with this purpose of securing water movement to the surface. We observe, however, in this connection, that under some geological relations of soil, it becomes important to preserve stored water, as well as to remove the water from cultivated sections.

PLANTING.

The compression of soil beneath the seed reëstablishes capillary connections which have become broken through the process of plowing and fitting the land, and hence is of avail towards supplying a constant access of moisture to the young plant; the firming of the soil above the seed tends to conserve the soil against waste of moisture as shown in our remarks concerning intercultural tillage. It is to these circumstances that we must ascribe the good effects often noted as following a spring shower just before seed has been planted, and which consolidates the soil against the undisturbed soil below, while the surface is fined in the process of planting. An experimental illustration of this explanation may be found on page 142 of our first report, 1882, with peas and cow peas, while corroborative evidence is given in the report of the first assistant for the present year.

MOISTURE.

Moisture is the leading essential for agriculture, as there is more or less fertility present in nearly all soils, for at least a small crop, and usually in excess of the requirement of a maximum crop. As a rule in farming, were moisture under our complete control, we would not be compelled to gain from addition of expensive fertilizer what might be more cheaply mined through the control of water, and we could extract from the soil fertility in the form of plant growth commensurate with the amount of nature's disintegrations and solvings, for indefinite periods without loss, and could, through the use of the manure of the farm and proper rotation, attain even to large crops without lessening the future productivity of our soil, each area of soil possessing its proper value as expressed in crop. This thought, however, depends for its carrying into practice upon an if. We have not as yet complete control over soil moisture. We have, however, a sufficient control, even at present, to justify careful and elaborate study in this direction, as a hopeful source for means of agricultural advance. Soil physics at the present time requires study and investigation far more than soil chemistry. The demand on the station should be rather for more work in this direction, than for repeating work already well done upon fertilizer, or for original investigation upon fertilizer, for soil physics should be brought into line with soil chemistry so that the two studies could be carried upward in unison, each supplementing the deficiencies in applying to practical ends the other.

FEEDING EXPERIMENTS.

The feeding experiment reported here was undertaken with reference to the study of the effect of the food upon the milk, and for this purpose a farrow cow was selected. This cow, Ceres, was of no breed, and was received in new milk December, 1884, the exact date of calving unknown. Her yield has been as below, by months :

	1885.	1886.	1887.
	lbs.	lbs.	lbs.
January	753	444	338
February	659	403	397
March	800	437	487
April	651	354	447
May	637	568	490
June	678	590	485
July	579	571	442
August	539	543	443
September	475	554	373
October	424	559	389
November	365	465	....
December	430	417	....
	6,990	5,905	....

The feeding was in twenty-day periods, and these, for the purpose of record and study, may be divided into five-day periods, and the data appear in the following table :

TABLE I.

PERIOD.	Live weight.	Hay, lbs.	Linseed meal, lbs.	Corn meal, lbs.	Bran, lbs.	Pumpkin, lbs.	Water. lbs.	Milk, lbs.
1.								
Dec. 1- 5	881	15.3	3.6	....	....	14.0	38.2	15.0
6-10	876	17.5	4.0	....	....	20.0	43.5	15.1
11-15	879	17.1	4.0	....	....	20.0	42.8	14.7
16-20	876	16.8	4.9	....	....	20.0	36.9	13.6
2.								
Dec. 21-25	867	14.4	......	....	....	....	40.3	12.3
26-30	854	14.3	......	....	....	....	35.6	10.6
31-Jan. 4	833	13.7	......	....	....	....	33.6	9.2
Jan. 5-9	825	12.9	......	....	....	....	35.6	8.8
3.								
Jan. 10-14	814	12.3	......	5.8	....	....	41.7	9.6
15-19	808	13.0	......	5.6	....	....	41.5	11.9
20-24	808	12.8	......	6.0	....	....	41.8	12.3
25-29	808	13.3	......	6.0	....	....	39.0	12.5
4.								
Jan 30-Feb. 3	816	14.6	......	2.7	4.8	....	53.1	12.6
Feb. 4- 8	835	16.4	......	3.0	4.8	....	60.9	13.6
9-13	845	15.8	......	3.0	5.0	....	60.8	14.3
14-18	849	15.6	......	3.0	5.0	....	57.4	14.9
5.								
Feb. 19-23	847	16.5	......	....	8.0	....	64.5	14.5
24-28	846	17.4	......	....	9.2	....	69.0	14.3
Mar. 1- 5	863	16.0	......	....	10.0	....	71.0	15.6
6-10	866	17.0	......	....	10.0	....	73.2	16.2
11-15	877	13.7	......	....	17.0	....	81.6	16.1

TABLE II.

DRY FOOD CONSUMED.

PERIOD.	Hay, lbs.	Linseed meal, lbs.	Corn meal, lbs.	Bran, lbs.	Pumpkin, lbs.	Total.
1.						
Dec. 1- 5	13.8	3.2	......	......	1.0	18.0
6-10	15.8	3.5	......	......	1.5	20.8
11-15	15.5	3.5	......	......	1.5	20.5
16-20	15.2	3.5	......	......	1.5	20.2
2.						
Dec. 21-25	12.9	......	......	......	....	12.9
26-30	12.9	......	......	......	....	12.9
31-Jan. 4	12.4	......	......	......	....	12.4
Jan. 5-9	11.7	......	......	......	....	11.7
3.						
Jan. 10-14	11.1	......	4.8	......	....	15.9
15-19	11.7	......	4.6	......	....	16.3
20-24	11.6	......	5.0	......	....	16.6
25-29	12.0	......	5.0	......	....	17.0
4.						
Jan. 30-Feb. 3	13.2	......	2.2	4.0	....	19.4
Feb. 4- 8	13.7	......	2.4	4.0	....	20.1
9-13	13.1	......	2.4	4.2	....	19.7
14-18	13.0	......	2.4	4.2	....	19.6
5.						
Feb. 19-23	13.8	......	......	6.8	....	20.6
24-28	14.5	......	......	7.8	....	22.3
Mar. 1- 5	13.4	......	......	8.5	....	21.9
6-10	14.2	......	......	8.5	....	22.7
Mar. 11-15	11.4	......	......	14.4	....	25.8

TABLE III.

PERIOD.	ALBUMINOID DAILY CONSUMED IN—					Total, lbs.
	Hay, lbs.	Linseed meal. lbs.	Corn meal. lbs.	Bran, lbs.	Pumpkin, lbs.	
1.						
Dec. 1- 5	1.38	1.28	......	......	.14	2.80
6-10	1.58	1.40	......	......	.21	3.19
11-15	1.55	1.40	......	......	.21	3.16
16-20	1.52	1.40	......	......	.21	3.13
2.						
Dec. 21-25	1.29	......	......	......	....	1.29
26-30	1.29	......	......	......	....	1.29
31-Jan. 4	1.24	......	......	......	....	1.24
Jan. 5-9	1.17	......	......	......	....	1.17
3.						
Jan. 10-14	1.11	......	.49	......	....	1.60
15-19	1.17	......	.47	......	....	1.64
20-24	1.16	......	.51	......	....	1.67
25-29	1.20	......	.51	......	....	1.71
4.						
Jan. 30-Feb. 3	1.32	......	.22	.66	....	2.20
Feb. 4- 8	1.17	......	.24	.66	....	2.07
9-13	1.12	......	.24	.70	....	2.06
14-18	1.11	......	.24	.70	....	2.05
5.						
Feb. 19-23	1.18	......	......	1.13	....	2.31
24-28	1.24	......	......	1.30	....	2.54
Mar. 1- 5	1.14	......	......	1.42	....	2.56
6-10	1.21	......	......	1.42	....	2.63
11-15	.97	......	......	2.40	....	3.37

The chemical data upon which these results are figured, is as below:

Date of sample.	FOOD.	Moisture.	Albuminoid.	Crude fiber.	Nitrogen free extract.	Fat.	Ash.
January 7	Hay	9.32	9.19	32.13	39.91	3.26	6.19
February 1	Hay	16.17	7.18	29.29	39.35	2.77	5.24
January 7	Linseed meal	11.61	35.52	11.75	28.22	8.34	4.56
January 7	Corn meal	16.96	8.56	1.98	66.92	4.19	1.39
January 7	Pumpkin	92.27	1.11	1.49	4.34	.16	.63
February 14	Wheat bran	15.05	14.18	9.21	53.02	2.95	5.59

Taking the last half of each period, when the influence of the preceding food may be supposed to have been largely eliminated, we have for the daily average of albuminoid fed, and product:

PERIODS.	Average daily albuminoid consumed, lbs.	Average daily live weight, lbs.	Average daily milk yield, lbs.
1	3.14	877	14.1
2	1.20	829	9.0
3	1.69	808	12.4
4	2.05	847	14.6
5	2.59	864	15.9

We note here that with increase of albuminoid fed, there appears in general an increase of milk yield and an increase in live weight, the exception being in periods one and five. In period one the albuminoid was mostly in the linseed meal; in period five, in the bran. The conclusion must therefore be, that: First, increase of albuminoid fed within the limits of this trial, is favorable to increase of milk and live weight. Second, that the albuminoid of the linseed meal is more favorable to live weight than is the albuminoid in the bran. Third, that the albuminoid in the bran is more favorable for milk yield than is the albuminoid in the linseed meal.

Expressed otherwise, so far as this one trial is concerned, linseed meal should be chosen as a leading portion of the ration where flesh is desired, and bran when milk is the object.

We may note also from the tables that the mixture of foods increased the amount of food consumed, and thus had a favorable effect upon the yield. Thus, during period two, of hay feeding alone, but 13.8 pounds of hay was daily eaten, while during period one, with linseed meal and pumpkins, 16.7 pounds of hay was utilized. During period five, with bran, 16.7 pounds of hay was consumed. We may hence infer that the mixture of foods was favorable in the inducing of a larger consumption, and that linseed meal and pumpkin, and wheat bran was of especial service, corn meal and bran less so, and corn meal yet less. As these conclusions, justified by this experiment, correspond to observed experience, we may deem them trustworthy.

An examination of the monthly milk yields, as given for Ceres, and also the milk yields under the periods of trial, we ascertain that milk flow can be increased by the feed given after diminution arising either from effect of previous feeding, or from the natural diminution which comes from distance from calving.

Examining our tabular data again, we can arrange another table, as below:

PERIOD.	Average daily water drank, lbs.	Extremes for 5-day periods, lbs.	Average daily milk yield, lbs.	Average daily water in food, lbs.	Total water in food and drink, lbs.
1	40.3	36.9—43.5	14.6	19.2	59.5
2	36.2	33.6—40.3	10.2	1.3	37.5
3	41.0	39.0—41.8	11.6	2.3	43.3
4	58.0	53.1—60.9	13.8	3.7	61.7
5	69.4	64.5—73.2	15.1	4.1	73.5

While last year, with cows in calf, we could trace no relationship between the amount of water drank and the milk yield, yet this year, with a farrow cow, such a relationship appears probable. Thus arranging according to the amount of water used:

PERIODS.	Water used, lbs.	Milk yield, lbs.
5	73.5	15.1
4	61.7	13.8
1	59.5	14.6
3	43.3	11.6
2	37.5	10.2

Eliminating, so far as possible, the influence of the previous food upon the milk, by taking the last five days of each period, and we have:

PERIODS.	Water consumed in food and drink, lbs.	Milk yield, lbs.	Albuminoid consumed, lbs.
5	77.5	16.2	2.63
4	61.4	14.9	2.05
1	47.5	13.6	3.13
3	41.3	12.5	1.71
2	36.8	8.8	1.17

And this last table brings out the relation with great clearness. We may also infer from the uniformity between the amounts of water drank during the five-day subdivisions of each period, that the amount drank was strongly influenced by the character of the food, more under the bran feeding than with the hay alone, etc., in the following order: Hay and bran; hay, corn meal and bran; hay, linseed meal and pumpkin; hay and corn meal; hay.

During these feeding trials, we have the following *nutritive ratio*, or the relation between the digestible albuminoids and the digestible carbohydrates, plus the digestible fat, multiplied by 2.5, the figures under which the calculations are made, being those gained by artificial digestion of the foods used in this trial, for the albuminoid, and those given by Armsby in his Manual of Cattle Feeding for the carbohydrates and fat.

TABLE OF DIGESTIBILITY.

	Albuminoid.	Crude fiber.	Nit.—Free extract.	Fat.
Hay—January 7	64.82	64.	67.	48.
February 1	40.18	57.	61.	49.
Linseed meal	89.87	26.	91.	91.
Corn meal	62.71	62.	91.	85.
Pumpkin	100.00?	100.?	100.?	100.?
Bran	79.92	20.	80.	80.

Calculating the rations fed, in accordance with this table, we have for the average daily ration:

PERIOD.	Digestible albuminoid, lbs.	Digestible carbohydrate and fat, lbs.	Nutritive ratio.
1	2.39	10.66	1:4.5
2	0.81	7.04	1:8.7
3	1.06	10.20	1:9.6
4	1.15	9.30	1:8.1
5	1.52	11.94	1:7.9

Arranging the nutritive ratios in connection with milk yield we have:

PERIOD.	Nutritive ratio.	Milk yield, lbs.
1	1:4.5	14.1
2	1:8.7	9.0
3	1:9.6	12.4
4	1:8.1	14.6
5	1:7.9	15.9

As the feeding was with respect to the total food, *ad libitum*, these figures are rather a surprise, and seem to lead to the inference already alluded to, that quantity of albuminoid consumed has a stronger relation to the milk yield than has the nutritive ratio.

The analyses of the milk made in the course of the experiment, the mixed night and morning's milk being used, find representation in the following table:

PERIODS.	Milk yield.		Water.	Fat.	Albumen.	Sugar.	Ash.	Total solids in day's milk oz.
1.	lbs.	oz.						
Dec. 1	13	9	85.60	5.03	3.70	4.94	.73	31.25
3	14	9	84.39	5.88	4.24	4.74	.75	36.37
6	15	3	84.11	5.91	4.20	5.15	.63	38.61
8	15	8	84.74	5.74	3.99	4.78	.75	37.84
10	15	0	84.59	5.72	3.92	5.08	.69	36.98
13	14	7	84.98	5.63	3.99	4.76	.64	34.70
15	15	2	85.02	5.49	4.02	4.76	.71	36.25
17	13	7	84.67	5.77	3.92	4.91	.73	32.96
20	14	10	85.02	5.32	4.05	4.91	.70	35.03
2.								
Dec. 21	14	5	84.88	5.54	4.18	4.65	.75	34.62
24	12	0	84.62	5.74	3.86	5.07	.71	29.53
27	11	6	84.84	5.85	3.86	4.77	.68	27.59
29	10	3	85.23	5.57	3.80	4.72	.68	24.18
31	9	10	84.96	5.68	4.05	4.73	.58	25.16
Jan. 3	9	2	85.44	5.29	3.86	4.73	.68	21.26
5	8	7	84.42	5.85	4.11	4.86	.76	21.03
7	9	1	85.29	5.62	3.86	4.56	.67	21.33
10	7	9	82.90	6.90	4.17	5.29	.74	20.69
3.								
Jan. 14	11	5	85.50	4.89	3.99	4.82	.80	26.24
17	11	11	85.97	4.42	4.05	4.75	.81	26.24
19	12	8	85.37	4.86	4.05	4.93	.79	29.26
21	12	8	85.17	4.96	3.42	5.71	.74	29.66
24	12	13	85.48	4.59	3.99	5.27	.67	29.77
26	12	7	86.51	4.42	3.74	4.69	.64	26.84
29	12	6	85.89	4.69	3.86	4.90	.66	27.94
4.								
Jan. 31	12	8	85.86	4.71	3.86	4.82	.75	28.28
Feb. 2	12	7	84.53	5.28	4.17	5.08	.84	30.59
5	13	11	85.54	4.85	3.99	4.85	.77	31.67
7	13	2	85.27	4.98	4.11	4.88	.76	30.93
11	14	14	85.55	4.77	3.86	5.06	.76	34.39
14	15	6	84.79	5.22	4.30	4.89	.80	37.42
16	14	14	85.38	4.99	3.99	4.95	.69	34.80
19	14	11	85.81	4.91	3.73	4.81	.74	33.35
5.								
Feb. 21	14	4	85.43	4.84	3.92	5.22	.59	33.22
23	14	7	85.75	4.83	3.92	4.82	.68	29.02
25	13	4	85.15	5.03	4.05	5.08	.69	32.08
28	15	0	84.93	4.87	5.44?	4.08?	.68	36.17
Mar. 3	16	8	85.95	4.61	3.61	5.16	.67	37.09
5	15	7	85.76	4.84	3.86	4.84	.70	35.17
7	15	11	84.95	5.55	3.99	4.84	.67	37.78
AVERAGE.								
1	14	6	84.79	5.61	4.00	4.89	.71	35.55
2	10	2	84.73	5.78	3.97	4.82	.70	25.04
3	12	2	85.70	4.69	3.87	5.01	.73	27.99
4	13	9	85.34	4.97	4.00	4.92	.77	32.68
5	14	9	85.42	4.94	4.11	4.86	.67	34.36

The average figures gained can be compared with the average digestible albuminoid consumed, and with the average water drank, as follows:

PERIODS.	Digestible albuminoid, lbs.	Water in food and drink, lbs.	Milk yield, lbs.	Total solids in milk, ozs.	Average fat, per cent.
1	2.39	47.5	14.1	35.5	5.61
5	1.52	77.5	15.9	34.3	4.94
4	1.15	61.4	14.6	32.6	4.97
3	1.06	41.3	12.4	27.9	4.69
2	0.81	36.8	9.0	25.0	5.78

We note that the total amount of solids in the milk indicates the influence of the albuminoid fed, and also upon the total yield, and yet does not seem to affect strongly the percentage of fat in the milk. It is probably a correct deduction, that by increased supply of albuminoid the milk flow is increased, and hence the total amount of fat and solids in the daily yield. We have had no results of experiments which offer decisive indications that in the presence of sufficient nutrition, the character of the food changes the percentage relations of the butter fat. It is more probable that richness of milk in butter fat is more dependent upon the individual or breed relations of the cow than upon the character of the food supply.

FEEDING FOR BEEF.

In an experiment with feeding for beef, we had for subjects the two calves purchased on July 14, 1885, as five weeks old, and reported upon in 1885. These calves weighed ninety-two pounds each on July 15, and "White Face," or Bess, weighing 194 pounds, "Red," or Jess, 161 pounds on September 7, the same amount of food having been offered each during these thirty-seven days, and a slightly larger amount having been consumed by Bess. The figures of increase for various periods can be best shown in tabular form, the conditions being alike amount of food offered each, and Bess consuming the larger quantity of food:

PERIODS.	EXTREME LIVE WEIGHTS DURING PERIODS.	
	"Bess," lbs.	"Jess," lbs.
July 14–31.—Milk	92 — 120	93 — 116
August 1–28.—Milk and grain	123 — 181	117 — 155
August 29–September 6.—Milk, grain and clover	183 — 195	157 — 162
September 7–22.—Milk, grain and clover.	194 — 207	161 — 175
September 23–October 7.—Grain and clover	220 — 235	186 — 195
October 8–22.—Grain and grass	241 — 265	196 — 215
December 7–January 4.—Hay and little grain	312 — 355	252 — 279

The following additional table gives the weights at different dates, in 1886, the feeding being of the ordinary character, hay and little grain or pasturage:

DATES.	"Bess," lbs.	"Jess," lbs.
February 1	387	313
March 1	430	354
April 6	461	386
June 1	563	462
July 3	616	510
August 3	618	525
December 1	753	590

BESS.

	Average weight lbs.	Extremes of weight during periods, lbs.	AVERAGE DAILY FOOD CONSUMED.					
			Hay, lbs.	Corn meal, lbs.	Linseed meal, lbs.	Ensilage, lbs.	Bran, lbs.	Water drank lbs.
Dec. 1-10	757	750-766	15.1	......	3.8	......	......	39.4
11-20	762	735-784	11.3	8.8	......	......	......	33.2
21-30	783	760-799	14.1	......	4.1	......	......	45.5
31-Jan. 9	813	804-820	12.6	8.6	......	......	......	34.9
Jan. 10-19	824	802-835	13.3	......	1.9	......	......	32.8
20-29	839	824-850	13.1	8.3	......	......	......	35.2
30-Feb. 8	857	844-868	13.9	......	3.2	7.0	......	38.4
Feb. 9-18	880	857-895	14.3	......	1.8	10.0	......	31.2
19-28	884	870-894	14.0	......	2.1	10.0	1.6	34.1
Mar. 1-10	894	873-912	12.9	......	3.1	10.0	2.0	31.5
11-20	895	873-910	13.4	......	4.0	2.0	4.5	44.6
21-30	923	898-935	13.7	......	4.0	......	6.0	45.2

JESS.

	Average weight lbs.	Extremes of weight during periods, lbs.	AVERAGE DAILY FOOD CONSUMED.					
			Hay, lbs.	Corn meal, lbs.	Linseed meal, lbs.	Ensilage, lbs.	Bran, lbs.	Water drank, lbs.
Dec. 1-10	585	574-603	5.2	5.1	......	......	......	14.9
11-20	593	581-601	7.1	......	2.6	......	......	20.4
21-30	600	588-609	4.6	6.8	......	......	......	15.7
31-Jan. 9	604	596-622	7.3	......	1.6	......	......	17.6
Jan. 10-19	622	610-632	6.4	7.4	......	......	......	19.6
20-29	632	603-648	10.7	......	0.7	......	......	19.1
30-Feb. 8	657	642-669	5.6	8.0	......	7.0	......	15.1
Feb. 9-18	675	648-691	4.2	10.0	......	10.0	......	19.9
19-28	701	683-713	4.8	8.7	......	10.0	1.5	18.7
Mar. 1-10	717	708-733	6.5	6.0	......	10.0	2.0	20.7
11-20	733	720-742	8.1	4.1	......	2.0	4.2	26.0
21-30	761	755-772	9.6	4.2	......	......	5.8	32.9

At the commencement of the winter's trial, these animals were hence about one year, five months and twenty-two days old. From the weighings of July and December 1, or one year, four months and seventeen days apart, we deduce an increase of live weight for Bess of 92 lbs. from 753 lbs., or 661 lbs., or 1.31 lbs. per day; for Jess, from 93 lbs. to 590 lbs., or 497 lbs., or 0.98 lbs. per day.

The statistics of the feeding trial are as below, the rule followed being to give hay *ad libitum*, and all the grain that each animal would eat.

We at once note the individuality of the two animals, an individuality which is pronounced throughout their whole career. As a calf and as a yearling, Jess consumed less food than Bess, and gained less in live weight, although as originally purchased, both as calves seemed of equal promise. This feature of individuality is sufficient to mask the influence of foods. Thus from December 1, 1886, to March 30, 1887, one hundred and twenty days, Bess changed from 757 to 923 lbs., or a gain of 166 lbs. for the average weighings; or from 750 lbs. to 935 lbs. for the extreme weighings, or an apparent gain of 185 lbs. Jess changed from 585 to 761 lbs., or 176 lbs. for the average weighings; or from 574 to 772 lbs. for the extremes of weight, 198 lbs. apparent gain.

We may hence say that Bess gained in flesh, during the 120 days, either 166 lbs. or 185 lbs., according to the series of figures used, while Jess gained either 176 or 198 lbs., according to the series of figures used. During this period the cattle consumed of food:

Bess — 1,617 lbs. hay; 257 lbs. corn meal; 280 lbs. linseed meal; 141 lbs. bran; 390 lbs. ensilage.

Jess — 801 lbs. hay; 603 lbs. corn meal; 49 lbs. linseed meal; 135 lbs. bran; 390 lbs. ensilage.

The albuminoid fed during this period of 120 days was:

	In hay.	In corn meal.	In linseed meal.	In ensilage.	In bran.	Total lbs.
Bess	137.75	22.00	99.45	3.15	20.00	232.35
Jess	67.78	53.75	17.40	3.15	19.40	161.22

This total albuminoid, reduced to its value in hay containing 9 per cent. of albuminoid, is equivalent to the feeding of 3,137 lbs. of hay to Bess and 1,791 lbs. of hay to Jess; or

In the case of Bess, 3,137 lbs. hay produced 166 or 185 lbs. live weight.

In the case of Jess, 1,791 lbs. hay produced 176 or 198 lbs. live weight.

Expressing this fact in another form, Bess gained 1.38 lbs. (or 1.54 lbs.) live weight per day, and Jess 1.46 lbs. (or 1.65 lbs.) per day; or, in the one case, that of Bess, 2.35 lbs. albuminoid fed daily was followed by 1.38 lbs. gain in live weight; in the case of Jess, 1.34 lbs. of albuminoid fed daily was followed by 1.46 lbs. daily increase of live weight.

The principal lesson to be derived from this trial is that conclusions drawn from experiments with few animals are extremely liable to be misleading, on account of the individuality of the animal used.

We may also note that under *ad libitum* feeding, the animals selected their own ration.

We may also note that under the circumstances of the feeding there was no profit, the increase costing more than the value of the flesh.

We may also note that from February 1 to December 1, 242 days, the average increase of live weight was 1.51 lbs. per day for Bess, and 1.14 lbs. for Jess, or a reverse result from the experimental period.

Such negative experiments as we have here reported have a certain value as showing the difficulties appertaining to the effort to generalize upon our work, and the necessity of constantly checking our experiimental opinions with those derived from practical experience. They also suggest that, as growth is in many cases an attribute of breed, whether for trials of this nature thoroughbreds should not in all cases be selected as subjects for feeding trials.

PLAT EXPERIMENTATION.

POTATOES.

The twenty-one plats, one-twentieth of an acre each, grouped under letter F, were planted with White Star potatoes on May 2 and 3, the seeding single eyes, the distances twelve by fourteen inches. No fertilizer was used, and the whole treatment at planting and afterwards as duplicate plats, cultivation having been practiced on May 21, June 6 and 7, June 25, July 11 and August 1. Harvesting took place September 27.

The question under investigation was as to the adequacy of the plat system to offer decisive results.

The land was in old sod in 1882, when possession was taken of the farm, and was first broken up in 1884, and from this date was subjected to various treatments and fertilizations. But three series have been exact duplicates from the commencement. These were: F 3 and F 4, corn, and 400 lbs. of fertilizer per acre in 1884; squashes, manured in the hill, in 1885; and potatoes, 400 lbs. of fertilizer per acre, in 1886.

The Yields.

C.	POTATOES.		POTATOES.	
	Merchantable, 1886.	Unmerchantable, 1886.	Merchantable, 1886.	Unmerchantable. 1887.
F 3	428.7 lbs.	55.0 lbs.	422.5 lbs.	33.7 lbs.
F 4	393.7 lbs.	42.5 lbs.	490.0 lbs.	20.7 lbs.

F 7 and F 9, squashes, manured in the hill, in 1884; tomatoes, in 1885; potatoes, with 400 lbs. fertilizer per acre, in 1886.

The Yields.

F.	POTATOES.		POTATOES.	
	Merchantable. 1886.	Unmerchantable, 1886.	Merchantable, 1886.	Unmerchantable. 1887.
F 7	321.5 lbs.	41.5 lbs.	421.7 lbs.	27.2 lbs.
F 9	145.2 lbs.	35.0 lbs.	428.0 lbs.	24.7 lbs.

F 17 and F 18 fallow in 1884; wheat, 400 lbs. fertilizer per acre, in 1885; corn, 400 lbs. fertilizer per acre, in 1886.

The Yields.

O.	CORN.		POTATOES.	
	Merchantable, 1887.	Unmerchantable, 1886.	Merchantable, 1886.	Unmerchantable, 1887.
F 17	574.7 lbs.	11.9 lbs.	459.2 lbs.	23.5 lbs.
F 18	70.8 lbs.	76.6 lbs.	312.2 lbs.	33.7 lbs.

In C we had adjoining plats, apparently in like condition in 1884, at the commencement of the trials; in 1886 F 4 yielding about twelve bushels per acre the less, and in 1887 about twenty-two bushels per acre the more; a variation of about two bushels per acre between the two years for F 3, and a variation of about thirty-two bushels per acre for F 4.

In F Series we note great variation in crop in 1886, and nearly identical crop in 1887, although more fertility must have been left in the soil of F 9 in 1876 than in F 7.

In O we had corn in 1886 under different methods of planting, and it is evident that less fertility was removed with the crop of F 18, in 1886, than with the crop of F 17. Yet in 1887, with potatoes, F 18 yielded about forty-nine bushels per acre less than F 17.

In F 19 we had a plat of like history with F 17 and 18, with the exception that no fertilizer was applied to the wheat of 1885. The yield of potatoes in 1887 was 377.5 pounds, merchantable, and 43.7 pounds unmerchantable. We notice here that while F 18 yielded about 104 bushels per acre, F 19, with less fertilizer in the rotation, and the same rotation, yielded about 126 bushels per acre, or 22 bushels per acre more.

Overlooking the rotations from 1884 to 1887, and considering only the fertilizer and manure applied, we can average our series and yields as below, calculated to acre areas:

PLAT.	Fertilizer in the rotation.	YIELD PER ACRE, BUS., 1887.	
		Merch.	Unmerch.
F I	400 lbs. fertilizer	148.9	9.6
F II	400 lbs. fertilizer	116.6	9.6
F 19	400 lbs. fertilizer	125.8	14.6
F 7	400 lbs. fertilizer and manure	140.6	8.7
F 8	400 lbs. fertilizer and manure	180.9	9.4
F 9	400 lbs. fertilizer and manure	141.0	8.2
F 10	400 lbs. fertilizer and manure	159.1	13.3
F 12	400 lbs. fertilizer and manure	143.3	6.6
F 14	400 lbs. fertilizer and 960 lbs. muriate potash	118.4	12.0
F 15	400 lbs. fertilizer and 1,120 lbs. sulph. potash	101.9	8.7
F 5	800 lbs. fertilizer	126.2	7.6
F 6	800 lbs. fertilizer	117.7	8.1
F 16	800 lbs. fertilizer	116.6	7.7
F 17	800 lbs. fertilizer	153.1	7.8
F 18	800 lbs. fertilizer	104.1	11.2
F 21	800 lbs. fertilizer	80.4	9.0
F 3	800 lbs. fertilizer and manure	140.8	11.2
F 4	800 lbs. fertilizer and manure	163.3	6.9
F 2	1,200 lbs. fertilizer	92.3	12.4
F 13	1,400 lbs. fertilizer	149.0	5.4
F 20	1,400 lbs. fertilizer	91.9	10.1

Summary and Averages.

	Extreme yields.	Average crop of merch.
3 plats, 400 lbs. fertilizer	116—148 bus.	130 bus.
5 plats, 400 lbs. fertilizer and manure	140—180 "	153 "
2 plats, 400 lbs. fertilizer and potash	101—118 "	110 "
6 plats, 800 lbs. fertilizer	80—153 "	116 "
2 plats, 800 lbs. fertilizer and manure	140—163 "	152 "
1 plat, 1,200 lbs. fertilizer	92 "	92 "
2 plats, 1,400 lbs. fertilizer	92—149 "	120 "

These figures with potatoes certainly offer no encouragement in favor of the plat system, and suggest what other considerations make probable, that the physical relations of our soil have a greater influence on crop than do the chemical relations.

We may perhaps be excused if we add, in the form of a postscript, fuller details concerning the two plats of largest and smallest yield.

Feb. 8. Yield	542.7 lbs. merchantable and	28.2 lbs. unmerchantable crop
Feb. 21. Yield	241.2 lbs. merchantable and	27.0 lbs. unmerchantable crop.
Difference	321.5 lbs.	1.2 lbs.
	107.1 bushels per acre.	0.4 bushels per acre.

F 8 in 1884 was planted with melons, with manure in the hills; in 1885 was planted to tomatoes, without manurial application; in 1886 was cropped with potatoes, 400 pounds of acid phosphate per acre being used. The yield was 129.2 pounds of merchantable, and 26.5 unmerchantable, or 43 bushels of merchantable potatoes per acre.

F 21 in 1884 was in pole beans, 400 pounds of fertilizer per acre having been used; in 1885, planted with squashes, no fertilizer being used; in 1886, planted with corn, 400 pounds fertilizer per acre. The yield was 152.2 pounds merchantable corn, and 14.4 pounds unmerchantable corn, or 38 bushels of merchantable per acre.

As a matter of record, we give the yield of each potato plat of the F series, in sequence, the plats being one-twentieth of an acre, as before stated :

	Merchantable, lbs.	Unmerchantable, lbs.	Rotten, lbs.
F 1	446.7	29.0	....
F 2	277.0	37.2	....
F 3	422.5	33.7	....
F 4	490.0	20.7	....
F 5	378.7	22.7	....
F 6	353.2	24.2	....
F 7	421.7	26.2	....
F 8	542.7	28.2	....
F 9	423.0	24.7	....
F 10	477.5	40.0	0.7
F 11	349.8	29.0	....
F 12	429.8	19.8	0.5
F 13	447.0	16.4	....
F 14	355.4	36.0	....
F 15	305.7	26.2	....
F 16	350.0	23.2	....
F 17	459.2	23.5	....
F 18	312.2	33.7	....
F 19	377.5	43.7	....
F 20	275.7	30.5	....
F 21	241.2	27.2	0.5

CORN.

The series C and E, of one-twentieth acre plats, were utilized as duplication tests, each plat in each series receiving like treatment. Series C was planted May 11, vegetated May 20 and 23, was cultivated June 8, June 30 and July 11, was stooked September 7, and harvested September 30. Series E was planted May 10, vegetated May 20 and 23, was cultivated May 24, June 6, June 25 and July 11, was stooked September 7, and harvested September 30. In either series the hills were 44 inches apart, and no fertilizer used. In figuring to bushels per acre, 80 pounds of ear corn are calculated as a bushel of shelled corn.

The tabular data of yields are as follows :

Series C.

PLAT.	No. of plants.	MERCHANTABLE EARS.		UNMERCHANTABLE EARS.	
		No. of ears.	Weight, lbs.	No. of ears.	Weight, lbs.
1	611	646	237.2	150	16.9
2	600	643	224.2	125	11.2
3	616	636	222.7	181	20.2
4	620	673	242.0	137	13.6
5	607	730	264.2	134	12.9
6	625	676	232.9	184	16.5
7	622	571	155.3	163	15.4
8	611	431	107.3	258	28.4
9	628	657	222.2	139	13.9
10	619	672	243.8	108	11.9
12	617	640	224.6	116	10.2
13	637	635	209.0	76	6.1
14	633	563	191.7	132	14.7
15	629	556	172.8	155	15.0
16	617	515	171.8	145	12.1
17	616	525	172.6	120	11.1
18	612	593	183.4	136	16.1
Average	619	609	204.6	145	14.5

Series E.

PLAT.	No. of plants.	MERCHANTABLE EARS.		UNMERCHANTABLE EARS.	
		No. of ears.	Weight, lbs.	No. of ears.	Weight, lbs.
1	629	694	223.8	137	11.6
2	640	650	216.9	118	8.2
3	624	631	199.0	190	18.6
5	625	663	222.2	157	13.9
6	624	613	196.1	139	11.7
7	629	558	174.2	152	15.5
8	626	562	182.7	158	15.8
9	612	628	213.6	167	15.9
10	623	589	197.6	185	19.9
11	621	563	186.0	179	18.9
12	615	519	168.1	169	16.1
13	603	518	169.1	134	15.2
14	591	535	177.6	148	16.0
15	614	554	177.5	166	20.6
16	597	555	167.1	240	27.2
17	596	574	182.2	212	24.8
18	612	510	150.1	258	27.4
19	608	470	140.2	247	30.4
20	612	450	128.2	186	17.6
Average	616	570	182.7	176	18.1

The two series, C and E, average as follows, calculated per acre:

	Series C.	Series E.
Number of plants	12,380	12,320
Number of ears, merchantable	12,180	11,400
Yield, bushels per acre, merchantable	51.1	45.7
Yield, bushels per acre, unmerchantable	3.6	4.5

The largest and smallest yields of the 17 plats in series C were, of merchantable corn, 66 bushels per acre for C 5, and 26.8 bushels per acre for C 8, a variation of 39.2 bushels. For the 19 plats of series E the largest yield was E 1, of 56 bushels per acre, the smallest yield E 20, of 32 bushels per acre, or a variation of 24 bushels, but as plat E 20 was occupied in part by the roots of a tree, we will take as the plat of least yield E 19, which gave 35 bushels per acre. The variation is hence 21 bushels.

The croppings of these plats were, for the various years:

C 5

1882.	Corn,	1,600	lbs. fertilizer per acre.
1883.	Potatoes,	400	" " "
1884.	Corn,	400	" " "
1885.	Fodder corn,	1,000	" " "
1886.	Potatoes,	400	" " "
		3,800	lbs. fertilizer.

C 8.

1882.	Corn,	400	lbs. fertilizer per acre.
1883.	Potatoes,	400	" " "
1884.	Fodder corn,	400	" " "
1885.	Fodder corn,	1,000	" " "
1886.	Potatoes,	400	" " "
		2,600	lbs. fertilizer.

E 1.

1882.	Sod.		
1883.	Corn,	400	lbs. fertilizer per acre.
1884.	Potatoes,	400	" " "
1885.	Cow peas,	400	" " "
1886.	Potatoes,	400	" " "
		1,600	lbs. fertilizer.

E 19.

1882.	Sod.		
1883.	Sorghum,	400	lbs. fertilizer per acre.
1884.	Potatoes,	400	" " "
1885.	Oats,	400	" " "
1886.	Corn,	400	" " "
		1,600	lbs. fertilizer.

In series C, we note that the plats of the largest and smallest yield have received during the rotation different quantities of fertilizer, but in series E these plats of varying yield have received the same fertilization.

In a number of the plats we have this year a like yield of merchantable corn, viz.: C 2, 3, 9, 12, and E 1 and 5. If the crop is governed by the fertilizer and previous history of the land, then these plats should all show a like history. The following summary shows, however, that the past treatment has been variable:

	1882.	1883.	
C 2	Corn, manure.	Potatoes.	
C 3	Corn, 800 lbs. fertilizer.	Potatoes	400 lbs. fertilizer.
C 9	Corn, 400 lbs. fertilizer.	Potatoes	400 lbs. fertilizer.
C 12	Corn, 400 lbs. fertilizer.	Potatoes	400 lbs. fertilizer.
E 1	Sod.	Corn	400 lbs. fertilizer.
E 5	Sod.	Corn	400 lbs. fertilizer.
Total fertilizer,	1,600 lbs. x manure.		2,000 lbs.

	1884.		1885.		1886.	
		Fert.		Fert.		
C 2.	Corn	400 lbs.	Corn	1,000 lbs.	Potatoes	400 lbs. fertilizer.
C 3.	Corn and cane,	400 lbs.	Corn	1,000 lbs.	Potatoes	400 lbs. fertilizer.
C 9.	Corn	400 lbs.	Corn	1,000 lbs.	Squash	400 lbs. fert. and man.
C 12.	Cane	400 lbs.	Cane	1,000 lbs.	Potatoes	400 lbs. fertilizer.
E 1.	Potatoes	400 lbs.	Cow peas	400 lbs.	Potatoes	400 lbs. fertilizer.
E 5.	Potatoes	400 lbs.	Corn	400 lbs.	Potatoes	400 lbs. fertilizer.
		2,400 lbs.		4,800 lbs.		2,400 lbs. x manure.

We may investigate yet further. In C 5, 7, 8, 12 and 13, we have substantially like treatment during the years 1882 to 1887, the same amount and kind of fertilizer being used each year on each plat. The yields have been per acre:

		C 5.	C 7.	C 8.	C 12.	C 13.
1882	Corn	62 bush.	No crop	28 bush.	52 bush.	50 bush.
1883	Potatoes	129 bush.	162 bush.	152 bush.	191 bush.	79 bush.
1884	Forage, green.	22½ tons.	11.0 tons.	8 tons.	19¼ tons.	50 bush. corn
1885	Forage, green.	19 tons.	12.0 tons.	19 tons.	28¾ tons.	23¾ tons.
1886	Potatoes	98 bush.	36 tons.	29 bush.	118 bush.	163 bush.
1887	Corn	66 bush.	38 tons.	27 bush.	56 bush.	52 bush.

In 1882, the corn was of different varieties; hence the figures are not strictly comparable. In 1883, the figures are all for crop, and the variation between the plat is quite large; in 1884 and 1885, the forage was of different sorts of corn and cane; in 1886, the potatoes represent different seedings; in 1887, the conditions all duplicate. The fertilizer used alike on all these plats was 400 lbs. per acre in 1882, 1883, 1884 and 1886; 1,000 lbs. per acre in 1885, and no fertilizer in 1887.

CONCLUSIONS.

These trials indicate the utter unreliability of field experimentation, and should suffice to convince the public of the lack of certainty which attends all general conclusions gained by this process. I trust the time may arrive when this plat work instead of being forced upon experiment stations, will be so condemned that if used at all, it shall be only with the apology of a special purpose to be served, and cultivated fields shall be relegated to their only true purpose in experimentation, that of verifying results otherwise gained, or for teaching practical methods of application, or for purposes of illustration. For six years now this station has devoted much expenditure and labor to its plat areas, forced by a mistaken public sentiment, and a review of its work indicates that little or nothing has been gained in the direction of manurial questions, or questions of a general nature relating to the growing of crops. The apparatus for station research are the laboratory, the study, the garden, the greenhouse and fields, which offer space for incidental uses, and whereon experimentation can be located. The fallacy of equal areas permanently staked off, and with a historical record of treatment, is too plausible to be at once overcome, and the idea appeals so strongly to the half-educated or uneducated mind as to secure intense belief and partisan advocacy, despite the continual proofs of failure which are constantly found in the examination of published records of this sort of pseudo-scientific, so-called experiment.

That I am not alone in these conclusions can be shown by quoting from Professor Dr. Paul Wagner, Director of the Agricultural Experimental Station at Darmstadt, Germany. In speaking of field experimentation he says: "They cannot be used as a means of scientific investigation, because their results are not obvious. Many people have been led into error by assuming that general conclusions could be deduced from such experiments." "Manurial questions of general importance cannot be solved in a reliable way by field experiment to satisfy the requirements of agriculturists." "In every scientific experiment it is essential that all circumstances which can influence the result of the research must be controlled. Manurial experiments on large patches of ground—even if only a few hundred square yards—do not allow such control. The investigator cannot regulate the influences which affect the plants; he cannot change bad, or produce favorable conditions; nor can he compensate for either. He must leave his experiment to all possible chances; to the changes of weather and to various kinds of injurious animals and insects. The dimensions of field experiment are too large to allow of exact treatment. When, however, the experiments are conducted on a condensed scale it is easy to control all the factors which influence the development of plants."

HOEING.

Although we consider the system of plat experimentation as totally unreliable for the purposes of generalization upon manurial questions, as never showing absolute relationships between fertility of land and crops, yet for the purposes of interpretation in terms of greater or less, it may sometimes be found useful as offering in its results, suggestions or verifications of ideas or conclusions elsewhere elaborated. For a useful purpose, however, even in these respects, each trial must be carefully investigated and results rejected which manifestly are dependent upon other causes than those which were intended to have applied. The following trial of the effect of intercultural tillage seems to show that the process is useful, but the rationale, which is probably a physiological question of root pruning and a physical question of retarding evaporation, finds no explanation in our trial, nor have we any note of the efficacy of the process in the given case, except the general result of increase of crop, and the special result of increase in one series and decrease in the other. It is evident that were our trials confined either to B upper or B lower, alone, the conclusions derived would have been radically different.

The trials in the B series were with Waushakum corn, the hills 44 inches apart, no fertilizer being used. B 2 was not hoed, but the weeds removed by hand. B 3 was hoed May 30, June 12 and July 9; B 4 was hoed May 26, June 4, 12, 18, 24, and July 2 and 11. The crops were stooked September 7, and harvested September 30.

PLAT.	No. of plants.	MERCHANTABLE.		UNMERCHANTABLE.	
		No. of ears.	Weight, lbs.	No. of ears.	Weight, lbs.
B 2. Upper	638	625	203.2	79	6.8
Lower	605	404	85.4	170	16.1
Total	1,243	1,029	288.6	249	22.9
B 3. Upper	641	636	208.1	75	5.9
Lower	602	510	136.3	156	12.5
Total	1,243	1,146	344.4	231	18.4
B 4. Upper	626	564	175.5	135	11.5
Lower	632	665	231.5	92	9.2
Total	1,258	1,229	407.0	227	20.7

If we consider our experiment as one trial, we have:

	No. of plants per acre.	MERCHANTABLE.	
		No. of ears, acre.	Yield per acre, bush.
B 2. Not hoed	12,430	10,290	36
B 3. Hoed three times	12,430	11,460	43
B 4. Hoed seven times	12,580	12,290	51

If we consider our experiment as in duplicate, we have:

	No. of plants per acre.	MERCHANTABLE.	
		No. of ears per acre.	Yield per acre, bush.
1.			
B 2 upper. Not hoed	12,760	12,500	51
B 3 upper. Hoed three times	12,820	12,720	52
B 4 upper. Hoed seven times	12,520	11,280	44
2.			
B 2 lower. Not hoed	12,100	8,080	21
B 3 lower. Hoed three times	12,040	10,200	34
B 4 lower. Hoed seven times	12,640	13,300	58

If we compare B 2 upper, not hoed, 51 bushels; B 3 lower, hoed three times, 34 bushels, and B 4 upper, hoed seven times, 44 bushels, we have again different figures, and so on through other changes. This trial is additional illustration of the indecisive evidence of plat work.

GENERAL CONSIDERATIONS.

"Is there any hope for agricultural experiment?" some may ask. I reply confidently that there was never better justification for high expectation than the present, but the hope must come through the acknowledgment of errors, and their abandonment. If we follow up successes, much can be accomplished. By working from the simple to the complex, and by investigating the separate factors which go towards making crop, by using logic boldly, and by interpreting justly, we may anticipate the obtaining of practical conclusions which shall possess the value of accuracy and certainty. We workers must openly claim that in agricultural experiment only exact scientific methods can avail, and must welcome all criticism which shows the inadequacy of our methods, and which suggests improved systems. In this my final report, I must freely acknowledge that I have yielded to public pressure in the past to a certain extent, and have practiced less boldly than I have believed, and have recorded much work which had better been omitted.

ENSILAGE.

In our fourth annual report, page 43, we gave particulars of a trial with the silo, the material merely thrown in, and no pressure applied. The present report is a continuation of the trial.

In 1886 the fodder corn was harvested on the dates and in the amounts as given below, being a mixture of the several races, viz.: dent, flint, sweet and pop. The weighings made of the material as ready for the silo:

Aug. 16	6,089 lbs.
Aug. 18	9,235 lbs.
Aug. 19	5,106 lbs.
Aug. 20	5,519 lbs.
	25,949 lbs., or 12.97 tons.

The fodder was cut in about one inch lengths, and thrown into the silo indifferently, no treading being done except what was incidental to the leveling of the last cutting, which was done by a man with a fork. No covering was used.

November 22 an examination was made. On the surface the fodder was found to be slightly dry; for eight inches below the surface decayed and blackish, and for the next four inches white and moldy. Below twelve inches, the ensilage is dry, hot and acidulous. At a depth of two feet, dry, acid, and the temperature 93°; at three feet, the temperature 86°, and at four feet 80°, and much moister than the upper layers, yet acid.

January 31, 1887, the silo was again opened. The first foot of ensilage was black, rotten and compact, and just beneath was a very thin layer of white mold; below this the ensilage appeared bright and clean with no apparent decomposition. Odor at two feet strongly acid, and holding the intensity of smell to a depth of three feet. The temperature at six inches was 63°, at twelve inches 73°, at eighteen inches 69°, and at twenty-four inches 65°.

The facts in regard to these two trials of 1885 and 1886, are that no pressure was applied, and that the quality of the ensilage was fully as good at the period of using as has been that of ensilage from the same silo when put up under the most careful system of filling and weighting. The loss by surface rotting has been in these trials no greater than *has* occurred under most careful systems of protection. The acidity of the contents has seemed no more pronounced than that which is usually observed in silo contents at the period of use.

The lesson of trials seems to be, that the condition requisite for the successful silo is exclusion of the air, and the presence of sufficient moisture. The means for obtaining this condition may be various, but these trials indicate that the weight of the upper layers of the material is sufficient to furnish the compression required for the successful preservation of the material below it, and as this compression is sufficiently accomplished before putrefactive fermentation can occur, there is but comparative slight loss through decay of the upper portion, while the actual surface exposed to the air becomes rather dry, and in a measure protective. It is to be noted that the upper layer, whose destruction protects the remainder, becomes decomposed only. It may strongly resemble cow dung in physical appearance, but has no putrefactive smell, at the most but that of wet and decaying wood.

Mildew and browning in ensilage does not render it unpalatable to cattle; indeed, as in dried fodder corn, it appears to act as a relish. Hence, as at present we view the proposition, the only loss in our silage is that thin layer near the surface which is absolutely rotten, and this forms but a small percentage of the mass. As this proportion must vary in its percentage to the total contents according to the capacity and the shape of the silo, it is useless to figure it for a given case.

From the experience gained at the station, we must believe that the true province of ensilage is to supplement other foods, and to serve as a condimental food, or as an appetizer. For this purpose the acid has been found, in the one careful trial made, to be beneficial. It is probably true that the amount which shall rationally constitute a portion of the daily ration, depends upon the amount of acid present, the less the acid the larger the amount which may be judiciously fed. We have never seen in corn silage any samples which have been free from acidity. We have noted that acidity is less in that portion of the silo which has been the moister at the time of filling, as the juices compressed from the material in filling have aided to exclude the air from the interstices. These observations may serve as guides for methods to be practiced in the preservation and expending of silage.

COMMERCIAL CABBAGE SEED GERMINATIONS.

The germination of cabbage seed from various seedsmen, the crop of 1885, and the trial made in January and February, 1887, gave the following figures for the white and red cabbaging class.

SEEDSMAN.	No. of packets.	No. of seed used.	No. of seed germinated.	Germination, per cent.
Gregory	36	7,200	5,173	71.8
Landreth	24	4,800	3,747	78.1
Henderson	23	4,600	3,540	76.9
Sibley	20	4,000	3,134	78.8
Thorburn	17	3,400	2,782	81.8
Tillinghast	8	1,600	1,515	94.7
Everitt	7	1,400	987	70.5
Department of Agriculture	6	1,200	1,079	89.9
Benary (Germany)	6	1,200	954	79.5
Damman & Co. (Italy)	6	1,200	577	48.1
Haage & Schmidt (Germany)	5	1,000	739	73.9
Burpee	2	400	333	83.2
Brill	2	400	341	85.2
Ferry	1	200	112	56.0
Johnson & Stokes	1	200	137	68.5
Total	164	32,800	25,150	76.7

The trials were made in duplicate, one hundred seed to each test. We noted, as has been reported by us in 1884, that but rarely exact duplication was obtained, and oftentimes a considerable variation between the results gained from the two samples counted from the same package of seed, and exposed to identical conditions. As a matter of interest we tabulate some variable trials, one for each of the seedsmen above named.

The greatest variation in a duplicate germination from same sample:

SEEDSMEN.	Per cent.	Per cent.
Gregory	87	60
Landreth	58	38
Henderson	98	74
Sibley	98	62
Thorburn	79	67
Tillinghast	86	64
Everitt	88	75
Department of Agriculture	99	90
Benary (Germany)	77	69
Damman & Co. (Italy)	54	26
Haage & Schmidt (Germany)	71	55
Burpee	98	93
Brill	97	88
Ferry	60	52
Johnson & Stokes	74	63

The series, as given, are not comparable for the purpose of obtaining information as to which seedsmen supply the best seed, as the number of trials differ. To make this evident, selecting the first six of our names, and arranging according to the magnitude of the germination per cents in this seed, we have the following order:

	Per cent.
Tillinghast	94.7
Thorburn	81.8
Sibley	78.8
Landreth	78.1
Henderson	76.9
Gregory	71.8

As we had but eight trials with Tillinghast, let us take the germination results of the first eight trials of the seed from the other seedsmen; our order of arrangement then stands:

	Per cent.
Tillinghast	94.7
Landreth	86.2
Gregory	80.0
Thorburn	77.8
Henderson	77.4
Sibley	73.6

This order would in turn be changed by any different grouping we could make from our figures, and if we desire to obtain information of this kind, we must use the same number of packets of the same varieties from each seedsman, and germinate under like conditions. From the trials here presented, we can legitimately refer to the seed from Tillinghast being of superior quality, but we cannot justly discriminate between the others named. We should mention, however, that Tillinghast's seeds were apparently in some cases selected for the purposes of trial, while the other tests were from strictly commercial samples.

DUPLICATION STUDIES.

Clawson wheat, twenty rows planted as duplicates 1886, gave the following figures, calculated to percentages. From 1,078 to 1,090 seeds constituted each planting:

ROW.	Vegetation percentage.	Per cent of plants survived winter.	Winter killing, per cent.
1	75	44	56
2	70	37	63
3	75	20	80
4	69	30	70
5	74	23	77
6	73	28	72
7	78	30	70
8	72	25	75
9	74	26	74
10	76	36	64
11	75	32	68
12	83	34	66
13	75	46	54
14	72	41	59
15	69	33	67
16	71	27	73
17	68	26	74
18	74	34	66
19	74	38	62
20	67	31	69
Average	73	32	68

Comparing the sums of the first ten and the second ten rows, we have:

	No. of seed planted.	No. of seed vegetated.	Winter killing, per cent.
First ten rows	10,848	7,989	2,393
Second ten rows	10,833	7,886	2,697
Whole twenty rows	21,681	15,865	5,090

Or expressing in percentages :

	Vegetation percentage.	Per cent of plants survived winter.	Winter killed.
First ten rows	74	30	70
Second ten rows	73	34	66
Whole twenty rows	73	32	68

Of the 21,681 seed planted, but 5,090 plants remained the following spring, or 23 per cent; that is, of the seeding 77 per cent was lost to the crop.

Using over 1,000 seed for a trial, the variation in the vegetation percentage between the rows is from 67 to 83 per cent; in the survivals through the winter, from 20 to 46 per cent, or the winter killing between these duplicate trials varied from 54 to 80 per cent of the plants that went through the winter. This variation is sufficiently large to discredit observations between plats containing this number of plants. When we figure, however, on the ten rows, we find that by using 10,000 plants, we secure sufficient uniformity. By dividing the plat into four parts of five rows each, we note the variation between the vegetation percentage is from 71 to 75; and for that of the winter survivals from 31 to 37. Probably many errors arise in experimenting by the overlooking of the numerical conditions which insure safety in comparative calculations. Had these trials, instead of being duplications been of seed from various sources, the temptation to have called the seed used on row 12 the best, and that on row 20 the poorest, would have been great; or if the results had been examined the spring following the planting, row 1 would have naturally been ascribed to the better seed, and row 3 to a poorer seed.

BOTANICAL NOTES.

In February some whole corn was fed to a cow. The washed dung furnished a number of kernels which had apparently passed unchanged through the digestive organs. Twenty-five of such kernels were dried and placed in a germinating apparatus. Thirteen, or 52 per cent germinated.

In March, some more whole corn was fed to a cow. Samples of dung containing apparently undigested kernels of corn were placed in a pot in the greenhouse, and left from March 21 to April 13, when all the corn had rotted, without germination. Parallel with this trial, thirty kernels of seed corn were mixed with fresh cow dung, and placed in the greenhouse to vegetate. March 27, one plant appeared, another on March 28, fourteen on March 30, and five on March 31. By April 13, the remaining seed were rotten. The germination under these conditions was hence 21 out of 30, or 70 per cent.

Does the size of seed differ in large and small fruits of the same variety?

	Weight of fruit.	Size of seed.	Weight of 100 seeds.
Hubbard squash.................	3 lbs. 5 ounces....	0.38x0.70 inches	325 grains.
Hubbard squash.................	3 lbs. 7 ounces....	0.50x0.79 inches	480 grains.
Field pumpkin....................	4 lbs. 0 ounces....	0.38x0.63 inches	70 grains.
Field pumpkin....................	8 lbs. 8 ounces....	0.47x0.82 inches	240 grains.

In 1884 we had among our seedling strawberries one plant bearing five leaflets instead of the normal three. In 1885 we received from John Lovel, a strawberry grower, of Driffield, England, plants of a five-leaved strawberry, named Filbert Pine (previously noticed in Nature, Vol. XXXI, p. 601). This peculiarity of the strawberry is by no means modern. In L'Horticulture Français, 1824, "le fraisier a 5 feuilles" is mentioned among the curiosities of culture, as also by Noisette in 1829, and Chabræus in 1677 quotes Brassavolus, an author of the early part of the sixteenth century, as affirming that strawberry plants with five leaflets are commonly to be met with in the fields about Verona.

The white-fruited form of *Fragaria vesca* is abundant in the fields about Skaneateles, N. Y., as Peck observes in the Twenty-Fourth Report of the New York State Botanist. I have myself found these white-fruited forms elsewhere. In culture we have Lennig's White. White strawberries are, however, by no means modern. White Alpine, White Chili and White Wood strawberries are named among cultivated varieties by Mawe, in 1778. White strawberries are mentioned by C. Bauhin in 1596, 1623, 1671; by J. Bauhin, 1651; by Swertius, 1654; by Chabræus, 1677; by Turre, 1685; are mentioned as wild by Tragus, 1552, and Dodonæus, 1616; as cultivated by Ruellivs, 1536; Mizaldus, 1560; Lobel, 1576; Camerarius, 1586; Porta, 1592; Gerarde, 1597; Quintyne, 1793, etc.

Strawberry plants are occasionally found with double flowers, and I have frequently noted specimens with more than the usual number of petals. The double-blossomed wood strawberry is named among varieties by Mawe in 1778, and Noisette in 1829. The double blooming are also named as a species by Morison in 1669, and in Blackwell's Herbarium, 1749, by Tournefort in 1700, etc.

While upon the subject of variation we may note that variegated leaved strawberries are recorded among species by Tournefort, 1700; the gold-striped and the silver-striped leaved among varieties by Mawe in 1778.

The wood and alpine strawberries, *Fragaria vesca*, as also *F. viridis*, the green, and *F. elatior*, the Hautbois, are European. The Virginian, *F. Virginiana*, is American and reached Europe in 1629. *F. Chiloense*, the Chilian, reached Europe in 1712.

EXPERIMENT STATIONS.

Six years' experience in directing an actual experiment station seems to make it incumbent upon me, now upon the point of severing my relations, to speak somewhat of the ideal experiment station, and this I shall do very briefly, not in the spirit of complaint from lost or unappreciated opportunity, but as formulating experience gained in the hope that others may be thereby benefited.

The work at a station carries with it much responsibility on the part of the direction. In order to be efficient, this direction should be single, and should be so arranged that responsibility for success or for failure should be placed definitely where it rightly belongs. The organization of the station is faulty in this respect, and I can speak of it the more willingly as my own personal relations with the Board of Control have been of the friendliest character from the beginning to the end of my service, and no criticisms of my own can apply to any individual member of our Board, but only to the system which they represent. There should be no board of control over any station, understanding the term to imply the relations which are now indicated by law, but the director should have the sole management and the sole responsibility. The functions of a board of control should be that of a board of supervision, a position which our board of control have wisely and properly taken, who should have sole control over the financial arrangements and over the appointment or the displacement of a director. If the director in his management does not meet the views of the board as to the policy which should prevail, or to their ideas of efficiency, then the director should be removed and another person in harmony with the policy of the board should be appointed. But so long as the director retains his appointment he should have full power to secure his own employes and to carry out his own ideas of work untrammeled and unhampered by any superior direction. This course is the proper one, because the character of the work which an experiment station is expected to accomplish must depend largely for its efficiency upon a unity of direction which cannot be expected to be obtained under committee management and through the annual change in the *personnel* of the board. The director, however, should outline his policy to harmonize with the views of the board or else resign, but there should be no half-way or compromise discordancies of view between the board and the director.

The policy which a station should pursue must vary somewhat according to the conditions it has to meet, but this may be safely said, that in general the efforts should be to eliminate local results from those which are general in their character, and to recognize that progress must come through work which has a permanent value. A large portion of the work which is done upon the station grounds, and with the regular working force of the station, could better be done elsewhere, and, indeed, cannot be done well when confined to one locality. Thus, work in pomology, which deals with varieties and variety adaptations, when confined to a specimen orchard, must in many cases be delusive, and in all cases cannot give the desired certainty of conclusion. This character of work can best be accomplished by the station maintaining a trained pomologist, whose duties shall involve the studying, through travel, of fruits as grown upon a large scale in nurseries, orchards or gardens, and who would have the privilege of referring any desired chemical or botanical questions which might arise to the station officials for study and elucidation. We may make like remarks concerning the study of breeds and the study of dairies. An expert, whose time should be spent in visiting herds or dairies and in making practical studies upon the spot, and whose conclusions should receive further study and investigation, where required, by the permanent station officials, would secure results which certainly would be reliable, and which might be of great importance. These two illustrations, which might be extended further, will serve to impress my conclusion that work at the station has been in the past entirely too local in its character, and that a policy which seeks for results and which ignores the farm, town, county or State lines, would be productive of larger benefits than have hitherto accrued to our work.

I think the Smithsonian plan of organization and work has not had the influence upon other organizations that its merits deserve. I would see our experiment station placed upon the Smithsonian footing, possessing a central band of workers to be engaged in independent research and the duties of revision and the putting out of distinct problems to selected individuals, those best capable of taking the work, regardless of their locality and residence. I would see criticism made rather upon the results obtained than upon the methods adopted. I desire to see that public and central support which would justify the director in acting upon the lessons of universal experience, and in abandoning popular directions of experiment, which are as useless in the present as they have been in the past.

To the public I would say that they are not interested especially in the work done at the station. Their interest is connected with the whys and wherefores of the explanations and suggestions which are founded upon the work which is accomplished. It can be of little value to the farmer to know that we have raised fifty bushels of wheat to the acre. The value to him of this work of ours must consist in our ability in explaining the conditions under which this crop was gained, and in formulating suggestions whereby such results can be secured elsewhere. Experiment is not farming, and experimental ideas are not farming ideas. Experiment must deal with the hard facts of science. Agricultural experiment means the transferring of results gained through science to practical applications. The direction for experimental work must be from the simple to the complex, from the known to the unknown, and all the conclusions which are based upon assumed facts gained by an opposite procedure must be viewed with suspicion.

Fertilizer analysis for the purpose of control is not experimental work, and has no relations whatsoever that I can see to experimental work, except the bare fact of the presence of a laboratory and a skilled chemist at the experiment station. Fortunately, our station has been freed from this duty of control, and therefore only such analyses are required to be made as seem to us proper from the circumstances attending each collection. The farming public, however, not only are careless in availing themselves of such privileges as our duty to other work allows us to offer, but many of those who send samples seem to think it a hardship that they are required to exercise care in the sampling and the furnishing data relating to the sample. The demand for analysis comes more largely from agents for their own private benefit than from the farmers themselves. When the expense, both in money and time, of an analysis is considered, it seems perfectly proper for us to deny the gift of an analysis to individuals, when such analysis can have no public interest. Expressing the matter more plainly, we should not analyze an unknown fertilizer for an individual, because the results are of no benefit except to the individual. If, however, the manufacturer, brand and analysis claimed or guaranteed, are furnished, then the results may become of public interest, and we should be justified in making the analysis. In matters of this kind our rules, while reasonably enacted, must be strenuously enforced, and no farmer should expect gratuitous work in this matter unless he is willing to conform to the regulations that we require.

I have been impressed more and more each year with the desirability, nay almost the necessity, of coöperation between stations in order to accomplish satisfactorily certain kinds of work. This coöperation should be, however, of a voluntary character, leaving each station its own independence. While coöperation might be wisely directed by a central authority, yet as between the stations themselves it is wise that no authority be assumed by any single station. The study of the influence of climate can scarcely be carried forward, or at least can be carried forward but with great difficulty and uncertainty, in one locality; and there are many questions relating to the climatic influence upon plants that we should know definitely about. The desirability of coöperative work may be catalogued as follows:

1. Meteorological work should be carried forward at all the stations under like conditions of exposure and record, in order that the results gained at various places may be truly comparable.
2. Analytical results should be tabulated in the same manner at each station.
3. A few kinds of plants should be grown at the various stations from seed of the same variety supplied from the same source.
4. There should be an agreement upon the methods of sampling in certain kinds of work.
5. A single problem for investigation should be annually agreed upon in which all the stations should take part.
6. There should be an annual meeting of directors for the purpose of discussing experimental problems and offering suggestions for mutual advantage.

An agricultural museum is one of the necessities for a proper study of agriculture, for without such aid we cannot hope to thoroughly understand either animal or vegetable problems. The station has not the means nor the room to enable a collection to be made or preserved, and perhaps it would not be desirable to make an adequate attempt even if means were more ample. A museum should be something more than a collection of curiosities. Such is the difficulty of preserving biological specimens that we cannot expect to have many complete collections. If the National Museum would attempt this work, the one collection at Washington would be sufficient for the needs of the whole country, if supplemented by smaller and local collections at our various agricultural colleges or experiment stations. At the present time I know of no collection in America which is sufficient to enable the complete study of one single vegetable under culture, or one single animal included in our farm economy.

The report of the First Assistant deals principally with the cereals, and represents much careful and painstaking work. It also gives in detail the results of trials in haymaking and with certain forage crops.

The report of the Horticulturist presents some experiments upon the physical relations of soil; these, while unfinished and scarcely sufficient for use in extended generalization, are yet of great interest, and serve to throw some light upon many causes which underlie crop production. Some years back your Director became convinced that lysimeters, as at present constructed, gave but fallacious data regarding the conditions which exist in a free soil, as the apparatus was not adapted for such a use, and as the resulting figures of drainage and drainage composition, logically interpreted, contradicted the observed facts of experience when carried out to their appropriate consummation. Mr. Goff, in the apparatus described in his report, seems to have overcome some difficulties, and seems to have designed a method of estimating the degree of certain changes which operate in a given soil, and which are allied to those occurring in a natural soil. In his report also will be found a continuation of the descriptive work on cultivated vegetables and various other data of horticultural interest, not the least of which are the verifications of previous work upon the influence of heredity as modifying the potato crop.

The report of the Assistant Horticulturist represents principally tabular data, which, taken in connection with our previous reports, will ultimately be found of service in studying the phenomenon of plant changes and influences of climate, especially when other data of like character are supplied by other institutions of similar character to our own, but working in a different region. His work on the potato scab seems to indicate that fungus is not directly accountable for this disease, but rather the alternations of checked and vigorous growth.

The work of the Chemist deals principally with butter-fat problems, and the work here recorded will, doubtless, be pronounced of permanent value. The digestion trials of the Assistant Chemist serve to add confidence to the results of this method, previously reported, while the various other problems discussed in his report furnish information of much practical interest.

There have been some changes in the *personnel* of the station staff during the calendar year. September 1, J. C. Arthur, the botanist, left to accept a professorship at Purdue University, Lafayette, Ind. October 1, our first assistant, Chas. S. Plumb, resigned to accept the professorship of agriculture at the University of Tennessee, Knoxville. His abilities, training and natural qualifications for the duties of his position make his loss a serious one. December 1, our chemist, S. M. Babcock, accepted a professorship at the University of Wisconsin. His leaving is much to be regretted, as this station deserves and should have the best talent, and should not allow superior inducements to deprive it of the services of efficient and growing investigators.

This loss through promotion of so many members of our staff speaks volumes for the value of the station as a training ground.

The property of the station is in excellent order; the expenses have, for the past year, been kept within the appropriation, and kindly relations have existed between the officers and employes, and yet continue.

GIFTS.

We are indebted to the publishers for the following list of newspapers and periodicals which have been sent to us free of charge:

American Analyst, New York, N. Y.
American Grange Bulletin, Cincinnati, Ohio.
Boston Weekly Post, Boston, Mass.
Bulletin d'Arboriculture, de Floriculture, etc., Gand.
Chautauqua Farmer, Dunkirk, N. Y.
Eastern Farmer, Waterville, Me.
Farm and Fireside, Springfield, Ohio.
Farmers' Journal, Hornellsville, N. Y.
Fruit and Grape Grower, Charlottesville, Va.
Hoard's Dairyman, Fort Atkinson, Wis.
Independent Statesman, Concord, N. H.
Industrialist, Manhattan, Kansas.
Massachusetts Ploughman, Boston, Mass.
Mirror and Farmer, Manchester, N. H.
National Live Stock Journal (weekly edition), Chicago, Ill.
National Live Stock Journal (monthly edition), Chicago, Ill.
New England Farmer, Boston, Mass.
New York Weekly Tribune, New York, N. Y.
Oil, Paint and Drug Reporter, New York, N. Y.
Orchard and Garden, Little Silver, N. J.
The Agricultural Epitomist, Indianapolis, Ind.
The American Cultivator, Boston, Mass.
The American Farmer, Baltimore, Md.
The American Florist, Chicago and New York.
The American Garden, New York, N. Y.
The American Rural Home, Rochester, N. Y.
The Cultivator and Country Gentleman, Albany, N. Y.

The Delaware Farm and Home, Dover, Del.
The Farmer, Malone, N. Y.
The Farmers' Advocate, London, Ontario, Canada.
The Farmers' Review, Chicago, Ill.
The Geneva Courier, Geneva, N. Y.
The Geneva Gazette, Geneva, N. Y.
The Home Farm, Augusta, Me.
The Husbandman, Elmira, N. Y.
The Jersey Bulletin, Indianapolis, Ind.
The Ladies' Home Companion, Springfield, Ohio.
The New England Homestead, Springfield, Mass.
The Orange County Farmer, Port Jervis, N. Y.
The Practical Farmer, Philadelphia, Pa.
The Rural New Yorker, New York, N. Y.
The Student's Farm Journal, Ames, Iowa.
The Weekly World, New York, N. Y.
Weekly Press, Philadelphia, Pa.

We desire also to acknowledge the following gifts, for which the donors have our hearty thanks:

November 12. Of D. W. Hinman, Peach Belt, Mich., 12 plants Fay's Prolific currant; also foliage, roots and wood of peach tree affected with "yellows."

November 16. Of D. Batchelor, seedsman, Utica, N. Y., a full assortment of capsicum seed.

February 15. Of A. B. Cleveland, seedsman, Cape Vincent, N. Y., a package of Alaska pea.

February 20. Of Dr. E. Palmer, Smithsonian Institution, Washington, Mexican sweet corn.

February 28. Of O. H. Alexander, seedsman, Charlotte, Vt., Montreal market cabbage seed, American Beauty peas.

February 28. Of Lucien Rust, Loudonville, O., seed of pop-corn.

March 4. Of J. S. Williston, Athens, Pa., package lettuce seed.

March 4. Of W. W. Rawson & Co., seedsmen, Boston, Mass., the offer of selection from their catalogue free of charge.

March 5. Of Daniel Batchelor, seedsman, Utica, N. Y., four packages of pepper seed and three of floral novelties.

March 5. Of J. M. Thorburn & Co., seedsmen, New York, N. Y., whatever seed in their line that may be desired.

March 7. Of W. W. Rawson & Co., seedsmen, Boston, Mass., five packages of vegetable seed.

March 17. Of Hemmingway's London Purple Co., New York, N. Y., 8 pounds London Purple.

March 19. Of C. A. Garfield, Grand Rapids, Mich., reports of Michigan Horticultural Society.

March 21. Of Dr. E. Palmer, Smith. Inst., Washington, D. C., seed from Mexico, viz.: Pachyrhizus angulatus, a gourd "Cidea Cayote," a sunflower "Mais de Teja," and Aglijria.

March 22. Of Hon. J. A. Wadsworth, M. C., Vol. XV, U. S. Census.

March 22. Of Silas L. Albertson, Roslyn, N. Y., seven packets cabbage seed.

March 26. Of B. K. Bliss, Boston, Mass., two packets tomato seed.

March 12. Of Hiram Sibley & Co., seedsmen, Rochester, N. Y., an assortment of seed.

April 1. Of Commissioner of Agriculture, Washington, D. C., numerous packages of vegetables, grass and cereal seeds.

April 4. Of J. M. Thorburn & Co., seedsmen, 15 John street, New York, N. Y., numerous packages of vegetable seeds.

April 4. Of E. M. Buechly, Greenville, Ohio, scions of Downing's Winter Maiden Blush apple.

April 4. Of A. H. Nixon, Dayton, Ohio, one Little Gem spraying pump, with set of Climax nozzles.

April 4. Of Peter Henderson & Co., seedsmen, 35 Cortlandt street, New York, N. Y., sample of seedling potato.

April 7. Of A. H. Ansley & Sons, Milo Center, Yates county, N. Y., package Ansley's Scarlet Flageolet wax bean.

April 7. Of Commissioner of Agriculture, Washington, D. C., three tubers Polaris potato; package of potato seed.

April 8. Of Commissioner of Agriculture, Washington, D. C., several packages of vegetable seed.

April 12. Of I. E. Tillinghast, seedsman, La Plume, Pa., several packages of vegetable seed.

April 12. Of E. L. Coy & Son, West Hebron, Washington county, N. Y., sample of seedling potato.

April 14. Of Commissioner of Agriculture, Washington, D. C., package of seed of Pyrethrum Roseum.

April 22. Of F. R. Palmer, Mansfield, Ohio, three plants of Palmer's seedling black cap raspberry.

April 25. Of A. W. Livingston's Sons, seedsmen, Columbus, O., three packets cabbage, and four packets cauliflower seed.

April 26. Of Chas. Carpenter, Kelley's Island, O., three plants Lucretia dewberry.

April 26. Of R. M. Morrill, Plymouth, Ind., sample of seedling potato.

April 27. Of J. A. Everitt & Co., seedsmen, Indianapolis, Ind., package Acme Evergreen sweet corn.

May. 4. Of J. D. Kruschke, Piqua, O., package sweet corn.

May 7. Of Merrill, Anthony & Co., Geneva, N. Y., one vine each of Black Madeira, Norwood, August Giant, Oriental, Bacchus, Red Wyoming, Empire State, and two each of Mary and a seedling No. 20.

May 13. Of J. J. H. Gregory, seedsman, Marblehead, Mass., samples of a new seedling potato.

May 13. Of J. D. Kruschke, Piqua, O., two dozen plants of Miami strawberry.

May 16. Of F. B. Mills, Thorn Hill, Onondaga county, N. Y., samples of Green Mountain potato.

May 17. Of G. S. Butler, Cromwell, Ct., four plants of a new raspberry, "Seedling No. 1."

May 17. Of C. C. Georgeson, Tokio, Japan, two packages of seed.

May 19. Of E. Jerome Woodford, West Candor, N. Y., package McDougal's Sheep Dip and Cattle Dressing.

May 26. Of J. G. Burrow, Fishkill, N. Y., one plant each of Downing and unnamed seedling grape.

June 1. Of the Zœktein Co., Albany, N. Y., package of an insecticide.

June 10. Of A. H. Nixon, Dayton, O., set Climax nozzles, with improvements on those previously sent.

June 25. Of S. F. Leonard, seedsman, Chicago, Ill., such seeds as we may order, free of charge.

June 28. Of Rose Manufacturing Co., New York, N. Y., package Tobacco Insecticide Soap.

July 5. Of Rose Manufacturing Co., New York, N. Y., fifty pounds Tobacco Insecticide Soap.

July 11. Of Benjamin Hammond, Fishkill, N. Y., sample packages "Hammond's Grape Dust."

July 16. Of Commissioner of Agriculture, Washington, D. C., fifteen packets turnip seed.

September 26. Of J. M. Thorburn & Co., seedsmen, New York, N. Y., flower seeds and bulbs.

September 30. Of Daniel Batchelor, seedsman, Utica, N. Y., samples of a new variety of bean.

September 18. Of W. S. Devol, Ohio Agricultural Experiment Station, seven packages of wheat.

September 18. Of William Rennie, seedsman, Toronto, Canada, ten packages of wheat.

October 1. Of Professor J. C. Arthur, LaFayette, Ind., some lavender plants.

October 31. Of H. C. Adams, Secretary, Reports of Wisconsin Horticultural Society for 1887.

INDEX OF SELECT SUBJECTS FROM PRECEDING REPORTS, 1882–86, NOT INCLUDING PRESENT REPORT.

Analyses. Ash Analyses of Corn Plant, 2d Rep., p. 163; Ash Analyses of Tobacco, 2d Rep., p. 163; of Individual Corn Stalks at various periods of growth, 2d Rep., p. 153; of Phenomenal Milk, 1st Rep., p. 25; 2d Rep., p. 156; 3d Rep., p. 60; Sugar in Corn Stalks, 1st Rep., p. 21; 2d Rep., p. 160; of Cattle Foods, etc., all Reports.

Artificial Digestion. Fourth Rep., p. 340; 5th Rep., p. 358. *We have here demonstrated that artificial digestion is a reliable method of determining the feeding value of approved foods, as distinguished from the potential value as determined by chemical analysis.*

Atavism the Result of Cross-fertilization. Third Rep., p. 154; 4th Rep., p. 97; 5th Rep., p. 54.

Barley. A Classification and Description of Varieties of, 3d Rep., p. 387; Weight of Seed, 3d Rep., p. 400.

Bean. A Special Description of Varieties, 1st Rep., p. 89; 2d Rep., p. 235.

Butter. Butter Yield more dependent upon the Character of than the Composition of the Food fed, 2d Rep., p. 114; Feeding of Wheat Bran advantageous towards recovery of Butter from the Milk, 2d Rep., p. 115; Relation of Butter to Fat in Milk, 3d Rep., p. 334; 4th Rep., p. 302; a Method of Detecting Adulterated Butters, 5th Rep., p. 338.

Cabbage. A Special Study of and Description of Varieties, 5th Rep., p. 185.

Cattle. Excrement Passed Daily, 5th Rep., p. 19; Water Drank Daily by, 5th Rep., pp. 20, 37.

Cattle Feeding. Digestion Experiments, 3d Rep., p. 26; Corn Fodder, Ensilage, Soja Bean, Hay, 3d Rep., p. 49; Brewers' Grains, 3d Rep., p. 49: *a good food, when in proper condition; no injurious effect, even when putrefacted, under good sanitary conditions and judicious feeding;* Relation of Feed to Milk, 2d Rep., p. 95; Influence of Salt, 2d Rep., p. 116: *increases the amount of water drank;* Acid Food, 3d Rep., p. 49; 4th Rep., pp. 16, 30, 32: *not injurious when fed in condimental quantities;* Starch Feed and Gluten Meal, 4th Rep., p. 15; Amount of Albuminoid Fed More Influential than the Character of the Food, 4th Rep., p. 30; 5th Rep., p. 37; Calf Feeding: Excess of Food over Maintenance Establishes the Profit, 4th Rep., pp. 35, 43; Individuality of the Animal a Potent Factor, all Reports, especially 3d Rep., p. 41; 4th Rep., p. 43; 5th Rep., p. 23; Water Drank vs. Milk Yield, 5th Rep., p. 37; Influence of Gestation on Milk Yield, 5th Rep., pp. 36, 37.

Cereals, Hygroscopic Properties of, 3d Rep., p. 79; Tillering, 5th Rep., p. 117. (See Corn, Wheat, Oats, etc.)

Churning, Economy of, Influenced by Character of Food Feed, 2d Rep., p. 116. (See Butter.)

Corn. Seed from Tip of Ear Superior to that from Butt, 1st Rep., p. 46; 2d Rep., p. 130; 3d Rep., p. 90; 4th Rep., p. 48; Deep Planting Injurious to Vegetation, but not to the plants which grow, 1st Rep., p. 51; 2d Rep., p. 138; Influence of Seed, 1st Rep., p. 43 (see also kindred references); Proportion of Seed that Actually Vegetates, 2d Rep., p. 139; Lowest Temperatures for Germination, 4th Rep., p. 84; Fodder Corn as a Forage Crop, 5th Rep., p. 46; Drying of Seed Corn Promotive of Vigor, 5th Rep., p. 40; Study of Maize, 2d Rep., p. 40; 3d Rep., p. 124; 4th Rep., p. 97; 5th Rep., p. 58; Classification of Varieties (illustrated), 3d Rep., p. 156; 5th Rep., p. 58; Relations of Crop to Temperature, 5th Rep., p. 38; Large vs. Small Seed, 4th Rep., p. 54.

Cross Fertilization of Corn, 1st Rep., p. 54; 3d Rep., p. 148 (see Corn, Study of;) of Various Varieties, 2d Rep., p. 222; of Tomato, 4th Rep., p. 211; of Pea, 3d Rep., p. 236; 4th Rep., p. 215; of Potato, 5th Rep., p. 150; of Barley, 3d Rep., p. 81; of Lettuce, 5th Rep., p. 54.

Duplicates. A Study of and Discussion of "Duplicates," 2d Rep., p. 119; 3d Rep., p. 62; 4th Rep., p. 47. *The importance of duplication as a test of value is proven, and the worthlessness of plat-experimentation without such a test is indicated, as well as the uncertainty of all classes of work wherein duplication cannot be attained.*

Germinations, 2d Rep., p. 273; 3d Rep., p. 105; 4th Rep., p. 70. *This experience proves the necessity of duplication in germination trials of a comparative nature, as also the importance of using in such trials a large number of seeds.*

Ensilage. May be Stored Without Pressure, 4th Rep., p. 43; Digestion of, 3d Rep., p. 26.

Fraudulent fertilizer, 4th Rep., p. 326.

Fruit. Influence of Pollen on the Form of Fruit in the Strawberry, 4th Rep., p. 255; 5th Rep., p. 179.

Fruits. Species Rarely Grown. Notices of our attempts. Huckleberry, 1st Rep., p. 145; 2d Rep., p. 227; 4th Rep., p. 259. Juneberry, 2d Rep., p. 226.

Germination of Seed. Age at which Seed Germinate, 5th Rep., p.

52 (see Unripe Seed); and Vegetation, 2d Rep., p. 260; duplicate, 2d Rep., p. 273; 3d Rep., p. 105. Lowest Temperature for Corn, 3d Rep., p. 118; of Mutilated Seed, 2d Rep., p. 64; Regermination, 2d Rep., p. 65; Trials, 2d Rep., pp. 59, 67; 3d Rep., p. 165; 4th Rep., p. 76; 5th Rep., p. 51.

Insect. Clover-leaf Weevil Disease, 4th Rep., p. 285; 5th Rep., p. 291; Practical Trials of Insecticides, all reports.

Laboratory. Examination of the Kjeldahl Method of Nitrogen Determination, 2d Rep., p. 164; Methods of Milk Analysis, 2d Rep., p. 167; Digestion Experiments (see Artificial Digestion); Butter Studies, 3d Rep., p. 334; 4th Rep., p. 302; 5th Rep., p. 330; Milk Studies, 4th Rep., p. 293: *here the milk globule is proven to have no envelope, and milk to be an emulsion;* Cooked vs. Raw Food, 4th Rep., p. 348: *in these trials cooking cattle feeds is shown to be not beneficial to the digestibility;* Phosphoric Acid: its Action on the Soil, 4th Rep., p. 349; Viscometry, 5th Rep., p. 316; Analyses, see all reports.

Lettuce, a special Study of and Description of Varieties, 4th Rep., p. 162.

Lysimeter Records, 1st Rep., p. 15; 2d Rep., p. 31; 3d Rep., p. 347; 4th Rep., p 321; 5th Rep., p. 346. *These records offer interesting data for future discussion. One fact proven is the influence of cultivation in conserving the water of the soil; another is the value of a grass crop as opposed to a fallow in preventing nitrogen waste.*

Maize, a Special Study of, 2d Rep., p. 40; 3d Rep., p. 124; 4th Rep., p. 95; 5th Rep., p. 58. Classification of Known Varieties, illustrated, 3d Rep., p. 156; 5th Rep., p. 58. See corn.

Milk. Composition of Total Daily Milk nearly unaffected by Food used, 2d Rep., p. 112; 4th Rep., p 32. Amount of Albuminoid fed Largely Determines the Milk Yield, 2d Rep., p. 113; 4th Rep., p. 310; also the total fat, 2d Rep., p. 113. Under full Feeding, Change of Food scarcely Affects the Proportion of Fat present in the Milk, 2d Rep., p. 113. Brewers' Grains not Detrimental to the Milk, 3d Rep., pp. 55, 58. Normal Decrease with Distance from Calving, 4th Rep., p. 28; 5th Rep., p. 21. Fat Globules not Enclosed in an Envelope, 4th Rep., p. 293. An Emulsion, 4th Rep., p. 296. Viscosity of, 5th Rep., p. 323. Phenomenally Rich, 1st Rep., p. 25; 3d Rep., p. 60.

Oats. A Classification and Description of Varieties of, 3d Rep., p. 390; 5th Rep., p. 97; Weight of Seed, 3d Rep., p. 401; Variety Influences on, 4th Rep., p. 56; Influence of Selection on, 4th Rep., p. 129.

Pea. A Special Study and Description of Varieties of, 3d Rep., p. 238.

Plant Diseases. Apple Blight, 3d Rep., p. 369; Apple Scab and Leaf Blight, 3d Rep., p. 370; Gummosis, 3d Rep., p. 375; Leaf Blight, 3d Rep., p. 367; Leaf Brownness, 3d Rep., pp. 368, 371; Leaf Mildew, 3d Rep., p. 371; Leaf Yellowing, 3d Rep., p. 319; Lettuce Mildew, 4th Rep., p. 279; Lettuce Rust, 4th Rep., p. 277; Peach Curl, 4th Rep., p. 373; Peach Yellows, 3d Rep., p. 372; Pear Blight, 3d Rep., p. 357; 4th Rep., p. 268; 5th Rep., p. 275; Plum Leaf Fungus, 5th Rep., p. 293; Quince Blight, 3d Rep., p. 371; Quince Rot, 3d Rep., p. 372; Rotting of Cherries and Plums, 4th Rep., p. 280; Smut in Oats, 3d Rep., p. 382; 4th Rep., p. 128; 5th Rep., p. 125; Spotting of Quinces, 4th Rep., p. 275; Strawberry Mildew, 5th Rep., p. 291; Tomato rot, 3d Rep., p. 379; 4th Rep., pp. 210, 276; 5th Rep., p. 289.

Potato. Seed End vs. Other Portions for Seed, 2d Rep., p. 123; 4th Rep., p. 230. *Of value as an experiment because the testimony is contradictory.* Tubers from Productive Hills Better for Seed Use than those from Unproductive Hills, 3d Rep., p. 301; 4th Rep., p. 232; 5th Rep., p. 150. *A striking indication of the value of this method of selection.* Rot attacks the more vigorous, or the latest varieties, 4th Rep., p. 239; General Work. See all reports. Varieties. See all reports.

Root Distribution, 5th Rep., p. 166. See Root Washings.

Root Washings. Asparagus, 3d Rep., p. 308; Bean, 5th Rep., p. 160; Beet, 3d Rep., p. 311; Cabbage, 3d Rep., p. 313; Carrot, 3d Rep., p. 312; Cauliflower, 2d Rep., p. 219; Celery, 3d Rep., p. 314; Chard, 3d Rep., p. 311; Corn, 4th Rep., p. 263; Corn salad, 5th Rep., p. 160; Egg Plant, 5th Rep., p. 161; Endive, 3d Rep., p. 308; Grasses, 4th Rep., p. 261; Kohl-rabi, 3d Rep., p. 313; Lettuce, 3d Rep., p. 307; Mangold, 4th Rep., p. 264; Melon, 3d Rep., p. 313; 5th Rep., p. 163; Okra, 5th Rep., p. 161; Onion, 3d Rep., p. 310; 5th Rep., p. 165; Parsley, 5th Rep., p. 162; Parsnip, 3d Rep., p. 311; Pea, 3d Rep., p. 306; Potato, 4th Rep., p. 263; Radish, 3d Rep., p. 310; Spinach, 3d Rep., p. 308; Squash, 5th Rep., p. 162; Strawberry, 2d Rep., p. 219; Tobacco, 4th Rep., p. 264; Tomato, 2d Rep., p. 219; Turnip, 5th Rep., p. 163.

Seed. From Earliest and Latest Pea-pods, 2d Rep., p. 204; *this trial indicates a gain in earliness;* from Most and Least Productive Pea Plants and Pods, 2d Rep., p. 204; 3d Rep., p. 233; from Green and Ripe Seed, 3d Rep., p. 224, 232; 4th Rep., pp. 154; Relation of Seed to Quality in Fruit, 1st Rep., p. 78; 4th Rep., p. 229; 5th Rep. p. 270; Use of Large vs. Small Seed, 4th Rep., pp. 54, 152, 155; from Various Parts of the Plant, 2d Rep., p. 38; 3d Rep., pp. 199, 211; 4th Rep., pp. 153, 216; see Corn; Unripe Seed, 2d Rep., p. 39; 4th Rep., pp. 162, 209; Earliest and Latest Germinating, 4th Rep., p. 211; Weight of Various Seeds, 1st Rep., p. 82; 2d Rep., p. 72; Weight of Seed and Color Corelated, 2d Rep., p. 62; Drying of Seed Corn Promotive of Vigor, 5th Rep., p. 40; from Earliest Ripened Tomato, 3d Rep., p. 224.

Soil. Stirring the soil conserves the water of the soil, and equivalent in its effect to a watering. Shown by Lysimeter Records. See all the Reports. Record of Soil Moisture, 5th Rep., p. 180.

Soil Temperature Records. See all Reports but the first.

Station. Duties of a, 1st Rep., p. 10; 2d Rep., p. 26; 3d Rep., p. 11; 5th Rep., pp. 5, 11.

Sunflower. Experimental Growing of the Seed, 2d Rep., p. 144.

Sunshine Records, 4th Rep., p. 334; 5th Rep., p. 348.

Temperature. Relation between Temperature and Crops, 4th Rep., p. 10; 5th Rep., p. 38; Records, all Reports; Soil Temperature, all Reports.

Tobacco. A Study on Tobacco Growing, 1st Rep., p. 148; 2d Rep., p. 227; 3d Rep., p. 326.

Tomato. A New Variety Originated, 5th Rep., p. 172; Influence of Heredity upon Vigor, 5th Rep., p. 173; Use of Unripe Seed, 3d Rep., p. 224; 4th Rep., p. 209: promotive of earliness, but accompanied by loss of vigor; Seed from Earliest Fruits, 3d Rep., p. 224.

Vegetables. Testing of, all Reports.

Weeds. Prolificacy of, 1st Rep., p. 85; Quality of, 4th Rep., p. 289; 5th Rep., p. 298; Parasitic Fungi on, 4th Rep., 291; Analyses of, 1st Rep., pp. 17, 18.

Wheat. Winter-killing of, 2d Rep., p. 140; Classification of Varieties, 5th Rep., p. 67; Study of Wheat Varieties, 4th Rep., p. 112; 5th Rep., p. 67.

REPORT OF THE FIRST ASSISTANT.*

The work of the First Assistant during 1887, as in previous years, has been mostly confined to assisting the Director in field and feeding experiments, to taking various meteorological and other observations, having a general oversight of the laborers of the station, and conducting such experiments in addition to these duties as circumstances would permit. This supplementary work has been specially confined to the cereals, grasses and forage plants. The following experiments reported upon were, practically speaking, finished. Other studies were in the course of progress, but not sufficiently completed for reporting upon, when the First Assistant was called to a new field of labor. The season of 1887 has been most unsatisfactory for the study of grasses owing to the exceedingly dry weather in April and May, when the grass crop most needed moisture. The plants did not attain their proper growth, and great difficulty was experienced in securing vegetation from spring sowings. Hence it is not thought advisable to report upon the grass plots, as no fair results can be recorded.

TESTING THE PRODUCTIVENESS OF WHEAT VARIETIES.

In testing the relative productiveness of varieties of farm and garden plants, the general custom is to plant equal quantities of seed over equal areas of ground, give the plants like treatment in every respect, and at harvest publish the result of the yields. The variety or varieties producing the greatest yields are generally noted as being especially productive, or more so than those which gave a less yield in this test. However, this method of testing varieties is fallacious, as it proves nothing. Of fifty varieties, Finley may lead the list one year in productiveness, and the next rank low in the scale. The reason for this difference in yield, one year with another, is due to varied climatic, soil and other conditions. Ten plats of one-twentieth of an acre each, equally treated in every respect, year after year, from uncontrollable circumstances, will not yield like results in the quantity of crop.

This being the case, how are we to determine the relative productiveness of varieties? With the aim in view of obtaining data that might enable experimenters to adopt more satisfactory methods for this character of work, the following experiments were executed:

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* C. S. Plumb.

A piece of ground exceeding 175 feet in length was selected for the test. The soil was a clay-loam, even in character, but for one feature, that of moisture, the western part of the ground being a trifle elevated on the eastern side, and somewhat drier. This piece of land, 175 by 33 feet, was plowed, harrowed and worked in a most thorough manner. After plowing, acid phosphate at the rate of 400 lbs. per acre was applied, and harrowed in. After a thorough pulverization of the soil, the varieties of wheat mentioned below were planted eighteen inches apart, in rows extending the length of the field, the seed in the rows being two inches distant. The depth of planting was one and one-half inches, and there was one row of each variety. This experiment was designed to occupy the place now filled by plat methods, for obtaining the comparative productiveness of varieties. While it is true that an equal number of plants of one variety may require a different area of ground from the same number of plants of another variety to come to perfect development, owing to the tillering or root habit, at present we have no means for determining the relative area of ground each variety should occupy in order to meet these requirements. Consequently, the following varieties were all planted under equal conditions, so nearly as could be secured:

No.	NAME OF VARIETY.	No. seeds planted.	No. seeds vegetated.	No. plants survived winter.	Per cent seeds vegetated.	Per cent plants survived winter	Weight of grain.		Weight of straw.	
1..	California Blue Stem	1,085	967	639	89.12	60.08	4 lbs.	11 ozs.	14 lbs.	6 ozs.
2..	Clawson	1,091	801	451	73.41	55.05	3	..	8	9
3..	Diehl—Mediterranean	1,087	1,012	644	93.10	63.53	5	2	11	9
4..	Dott	1,087	930	434	85.54	46.66	3	..	7	15
5..	Dietz White Chaff	1,084	917	464	84.50	50.59	3	14	9	10
6..	Everitt's High Grade	1,083	987	336	81.22	34.05	2	7	7	..
7..	Extra Early Oakley	1,084	803	180	74.07	22.41	..	13	2	6
8..	Finley	1,084	889	393	82.01	44.20	3	1	7	10
9..	Fulcaster	1,084	883	378	81.45	42.80	3	2	7	8
10..	Fultz	1,084	1,058	464	97.60	43.85	3	12	9	9
11..	Genoese	1,084	867	18	70.75	2.07	..	2	..	6
12..	German Emperor	1,088	818	290	75.10	35.45	2	7	6	7
13..	Golden Drop	1,086	774	362	71.26	46.77	3	3	7	12
14..	Golden Straw	1,088	721	155	66.26	21.49	..	14	2	15
15..	Indian	1,087	70	....	6.43	....	..	..	..	..
16..	Lancaster	1,085	884	201	81.47	22.73	1	6	4	5
17..	Landreth	1,085	491	98	45.25	19.95	..	12	2	6
18..	Lovett	1,085	780	172	71.88	22.05	1	3	3	12
19..	Martin's Amber	1,086	841	297	77.44	34.11	2	6	6	15
20..	McGhee's Red	1,085	682	159	68.85	23.31	1	4	3	4
21..	McGhee's White	1,085	711	152	65.52	21.36	..	12	1	8
22..	Mediterranean	1,084	966	351	89.11	36.33	2	..	5	9
23..	"Pittsford"	1,084	635	94	58.57	14.80	..	9	1	..
24..	Raub's Black Prolific	1,084	740	284	68.26	38.37	3	0	5	8
25..	Rice	1,084	920	282	84.87	30.65	2	4	5	7
26..	Russian May	1,084	866	304	79.88	35.10	1	12	4	7
27..	Surprise	1,084	901	330	83.11	36.62	2	7	4	12
28..	Scott (bearded)	1,084	963	495	88.82	51.40	4	12	9	11
29..	Sheriff's Four-rowed	1,084	766	43	7.06	5.61	..	3	..	12
30..	Swamp	1,084	978	547	90.22	55.92	5	5	12	..
31..	Theiss	1,084	524	156	48.33	29.77	1	8	3	13
32..	Travis	1,084	733	197	67.61	26.87	1	13	6	12
33..	Treadwell (bearded)	1,084	782	326	72.14	41.68	2	14	7	13
34..	Valley	1,084	783	351	72.23	44.82	3	9	8	3
35..	Velvet Chaff	1,084	835	541	77.02	64.79	5	6	11	14
36..	Wayne County Select	1,084	720	251	66.42	34.86	2	1	6	..
37..	Washington Glass	1,084	498	137	45.94	27.51	1	6	3	15
38..	White Blue Stem	1,085	895	530	82.48	59.21	5	7	13	8
39..	White Crimean	1,086	645	....	59.39	....	..	..	..	..
40..	White Eldorado	1,085	622	320	57.32	51.44	3	7	9	4
41..	White Rogers	1,085	749	346	69.03	46.19	4	5	13	15
42..	White Velvet	1,085	641	306	59.07	47.73	3	12	9	10
43..	York White Chaff	1,085	774	396	71.33	51.29	4	5	12	5
44..	Zimmerman	1,085	727	416	67.00	57.22	4	3	13	15

Grouping the ten varieties that passed the greatest percentage of plants safely through the winter, no apparent relation is to be seen between the per cent of plants which survived the winter and the yield of grain. Carrying this comparison further, no relation seems to exist between the yield, number and per cent of plants which survived the winter, as is seen below.

NAME OF VARIETY.	Rank in productiveness.	No. plants survived winter.	Per cent plants survived winter.	Yield.
White Blue Stem	1	530	59.21	5 lbs. 7 ozs.
Velvet Chaff	2	541	64.79	5 " 6 "
Swamp	3	547	55.92	5 " 5 "
Diehl-Mediterranean	4	644	63.53	5 " 2 "
Scott (bearded)	5	495	51.40	4 " 12 "
California Blue Stem	6	639	66.08	4 " 11 "
York White Chaff	7	396	51.29	4 " 5 "
Zimmerman	8	416	57.22	4 " 3 "
White Eldorado	9	320	51.44	3 " 7 "
Clawson	10	451	55.05	3 " 0 "

In order to determine, however, the value of duplicate results in testing one variety after this manner, twenty rows of Clawson wheat were planted in a manner indentical with the varieties. The soil in which these twenty rows were placed, was very even in its character, so that as far as external features went, the ground seemed very suitable. In the twenty rows were planted 21,681 seeds, an average of 1,084 to each row, and of these 15,865 vegetated, or 793 on an average to each row, or 72.59 per cent per row. Of the total number of seeds that vegetated, 5,090 survived the winter, averaging 254 to the row, or 32.03 per cent per row. The yield of grain from the 5,090 plants was 53 lbs. 7 ozs., an average of 3 lbs. 9 ozs. per row; of straw, 127 lbs. 9 ozs., an average of 6 lbs. 7 ozs. per row. In this experiment of duplicates, the results are fully as contradictory as in a duplicate set of plat experiments, the extremes in yield ranging from 1 lb. 11 ozs. in one row to 4 lbs. 5 ozs. of grain in another. A like variation exists in both seed vegetation and winter survival of plants. In the former case the extremes are 719 — 853; in the latter 165 — 372.

Confirming results by means of duplication is the only method by which we can hope to secure reasonably correct returns, as thereby the limit of errors may be carefully drawn. The case of this experiment simply offers additional evidence to prove the weakness of plat experimentation, and supplies data for explaining wherein this weakness lies. Until we shall be able to prove what factors are essential to correctly test the productiveness of varieties, and be able to control or interpret the workings of these factors, we cannot hope to intelligently solve this problem by means of the plat system. That we have not thus far must be conceded; that we may ultimately succeed, we may be allowed to hope.

WHEAT PLANTING UNDER VARIABLE CONDITIONS.

A plat one-twentieth of an acre in size was fitted for wheat in the customary manner, the ground being plowed and harrowed thoroughly. Fertilizer at the rate of 400 pounds per acre was applied after plowing, and harrowed in. Eighteen rows were marked out, extending north and south, each being twenty-two inches apart and sixty-six feet long. The seed was sowed two inches apart in the row. The eighteen rows were divided into three sets, there being six rows to a set. The seed was covered to a depth of an inch and a half. The rows were treated as follows: The grain in row one was lightly covered with earth, by pulling it over the seed by means of a hoe, and the soil left undisturbed; the soil hoed over row two was walked on by the man hoeing; row three was tapped in the ordinary fashion with the blade of a hoe; the bottom of the drill of row four was beaten hard before planting, and after the seed was sowed, was covered with soil, and tapped lightly with the hoe; row five was planted, and the soil on it beaten hard with a maul; row six after planting was compacted by passing a roller over it. The succeeding six rows were planted as the preceding, and the next six the same. During the growing season the rows were hoed as occasion required. The winter was quite severe, and the plants suffered in the spring from freezing and thawing, but this served as a good test of the adaptability of the various methods to the climatic conditions. The variety used was the Clawson. The following table explains itself:

Row.	TREATMENT OF ROWS.	No. seeds planted.	Seeds vegetated.	Plants survived winter.	Per cent seed vegetated.	Per cent plants surviving winter.	Weight of grain, ozs.	Weight of straw, ozs.
1....	Covered lightly with soil..........	406	237	14	58.37	5.90	1	6
2....	Walked on..........................	406	320	114	78.76	35.62	13	33
3....	Tapped with hoe....................	407	294	24	72.23	8.16	2	6
4....	Bottom of drill compacted........	407	263	75	64.61	28.51	12	28
5....	Beaten hard with maul...........	407	313	94	76.90	30.03	11	25
6....	Rolled...............................	406	317	125	78.07	39.43	18	37
7....	Covered lightly with soil..........	406	221	46	54.43	20.81	6	12
8....	Walked on..........................	406	309	110	76.10	35.59	14	30
9....	Tapped with hoe....................	406	270	21	66.50	7.77	2	6
10....	Bottom of drill compacted........	406	275	138	67.70	50.18	16	37
11....	Beaten hard with maul...........	406	312	96	76.84	30.76	11	24
12....	Rolled...............................	407	326	120	80.09	36.80	14	32
13....	Covered lightly with soil..........	406	231	42	56.89	18.18	5	15
14....	Walked on..........................	406	325	99	80.04	30.46	12	11
15....	Tapped with hoe....................	406	319	21	78.57	6.58	1	6
16....	Bottom of drill compacted........	406	285	116	70.19	40.70	14	32
17....	Beaten hard with maul...........	407	333	61	81.81	18.31	6	18
18....	Rolled...............................	407	314	59	77.14	18.78	5	14

Grouping the six methods of treatment, we are better enabled to compare the duplicate rows, as well as the other plantings:

	ROWS 1, 7, 13 — COVERED LIGHTLY WITH SOIL.		ROWS 2, 8, 14—WALKED ON.		ROWS 3, 9, 15 — TAPPED WITH HOE.	
	Per cent plants survived winter.	Yield. grain.	Per cent plants survived winter.	Yield grain.	Per cent plants survived winter.	Yield grain.
1..........	5.90	1	35.62	13	8.16	2
2..........	20.81	6	35.59	14	7.77	2
3..........	18.18	5	30.46	12	6.58	1
Average ..	14.96	4	33.89	13	7.50	1.66

	ROWS 4, 10, 16—BOTTOM OF DRILL COMPACTED.		ROWS 5, 11, 17 — BEATEN HARD WITH MAUL.		ROWS 6, 12, 18 — ROLLED.	
	Per cent plants survived winter.	Yield grain.	Per cent plants survived winter.	Yield grain.	Per cent plants survived winter.	Yield grain.
1..........	28.51	12	30.03	11	39.43	18
2..........	50.18	16	30.76	11	36.80	14
3..........	40.70	14	18.31	6	18.78	5
Average ..	39.79	14	26.36	9.33	31.67	12.33

These figures present strong evidence that compacting the soil in wheat culture aids the plant to resist winter-killing, and favors increased yield of crop. This is noticeable in all the cases where the most pressure was applied to the soil, and noticeably with rows 4, 10, 16, where the earth beneath the seed was very compact.

Periods of Cutting Barley.

On April 25, sixteen varieties of barley were sown on clayey-loam soil, in good condition, and well adapted to barley. No fertilizer was applied, and the ground was plowed and carefully harrowed before planting. The rows were planted twenty-four inches apart, with seed two inches apart in the row. The seeds vegetated, and the plants made a most vigorous and successful growth.

Of the varieties planted, nine were selected for cutting at different periods for the purpose of noting the effect on the weight of the seed. The first cutting was made on July 20, when the plants were all ripening, and yet were noticeably green. On July 27 the second cutting was made, when the plants were apparently in a fair condition for cutting, being neither green nor over ripe. The third and final cutting was made on August 2, when the plants were what might be termed "dead ripe," the green matter having entirely disappeared.

After threshing, 1,000 kernels were counted out from the cuttings of the different varieties, and carefully weighed on the balance. It is but proper to say that there was much resemblance in the maturing of the plants in all nine rows. The seed planted came from Vilmorin, Andrieux et Cie., Paris, France, and the following are the varieties tested: Escourgeon Black, Escourgeon Spring, Guymalaye or Namto, Italian, Large Naked, Rice, Six-rowed, Two-rowed, and Very Early Lapland. The following table explains itself:

VARIETIES OF BARLEY TESTED.

Weight in Grams of 1,000 *Grains.*

DATE CUT.	Escourgeon Black.	Escourgeon Spring.	Guymalaye.	Italian.	Large Naked.	Rice.	Six-rowed.	Two-rowed Black.	Very Early Lapland.
	gr.	gr.	gr.	gr.	gr.	gr.	gr.	gr.	gr.
July 20	43.4	37.1	39.4	44.4	56.8	48.5	32.6	47.9	40.3
27	46.1	36.9	40.8	49.3	58.7	47.5	32.8	49.2	39.1
Aug. 2	45.7	39.3	41.1	50.4	64.6	49.1	34.4	51.6	41.6
Second weighing:									
July 20	44.4*	36.7	......	......	......	......	......	......	......
27	45.6	37.3	......	......	......	......	......	......	......
Aug. 2	46.2	38.5	......	......	......	......	......	......	......

The above table offers some very interesting figures. In every case excepting that of Escourgeon Spring barley, the third cutting gave heavier grain than did the first. A second weighing was made of the grain of this variety, which resulted in giving a sequence in weight analogous to the other eight. In five of the nine varieties the increase in weight was constant from the first to the last. A second weighing of the three cuttings of Escourgeon Spring was also made, with the result that the returning figures gave a constant increase from first to last cutting.

Adding the gross figures together for the several cuttings, we find that 9,000 kernels from the cutting of July 20 weighed 390.4 grams; the second cutting 400.4 grams, and the third 418.0 grams. The average weight of 1,000 kernels of these nine varieties gives 43.4 grams for the first cutting, 44.5 grams for the second and 46.4 grams for the third.

While this experiment cannot be regarded as conclusive, the results secured positively indicate, so far as they go, that for the year 1887, under the conditions in which this barley was planted and grown, that plants which fully matured and ripened before cutting produced heavier grain than those cut at early or medium maturity.

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* But 500 grains were weighed in this variety the second time, owing to lack of kernels. This quantity is multiplied by two to give the approximate weight of 1,000 grains.

Maercker* states from experiments carried on relating to the chemical composition of barley, that the harvest should be made at dead-ripeness, or at least full ripeness for good quality. If the above experiment does not point toward wrong conclusions, then it may reasonably be considered that good quality and heavy weight of grain occur to the most certain extent, other things being equal, when the grain is fully or dead ripe.

EFFECT OF SIZE OF SEED ON RESULTING OAT CROP.

From the farm granary 1,000 of the smallest and an equal number of the largest oat seed were carefully selected. While the aim was to secure extremes so far as size was concerned, the matter of vitality was not overlooked. The 1,000 large grains, which we will designate as A, weighed one and one-fourth ounces; the small lot nine-sixteenths of an ounce. On May 4 the lots A and B were planted side by side in four rows each, there being 250 seeds in each row. The clay-loam soil was fairly moist, not manured, and in a very good condition of tillage. The rows were placed two feet apart, the seed being about three inches apart in the row.

On May 12 it was noted that the selected large seeds were vegetating more rapidly than were the small, and were making a good growth. On June 8 the number of vegetations were found to be as follows: Large seed, 823 plants; small, 650. June 23 it was noted that the plants on A rows were larger and more robust, and had a taller growth than the plants of B. As the season advanced the plants from large seed began to ripen slightly in advance over those from small seed. On August 6 both large and small seedings were cut. The plants of the individual rows of each lot were threshed separately, with the following results:

ROW.	LOT A — LARGE.		LOT B — SMALL.	
	Grain.	Straw.	Grain.	Straw.
1	3 lbs. 4 ozs.	9 lbs. 2 ozs.	2 lbs. 6 ozs.	8 lbs. 11 ozs.
2	2 lbs. 9 ozs.	8 lbs. 8 ozs.	1 lb. 14 ozs.	7 lbs. 12 ozs.
3	2 lbs. 10 ozs.	7 lbs. 15 ozs.	2 lbs. 1 oz.	7 lbs. 13 ozs.
4	3 lbs. 7 ozs.	9 lbs. 3 ozs.	2 lbs. 10 ozs.	8 lbs. 2 ozs.
Total	11 lbs. 14 ozs.	34 lbs. 12 ozs.	8 lbs. 15 ozs.	32 lbs. 6 ozs.

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* Biedermann's Centralblatt fur Agrikulturchemie, 1886.

Of the grain produced, 10,000 seeds of each lot were carefully weighed on the balance, with the following result:

	Lot A—Large Seed.			Lot B—Large Seed.	
Row 1	20.30	grams.	Row 1	18.80	grams.
2	20.00	"	2	18.80	"
3	20.50	"	3	19.00	"
4	19.70	"	4	19.20	"
5	19.60	"	5	19.10	"
6	20.20	"	6	19.00	"
7	19.90	"	7	20.60	"
8	19.50	"	8	19.40	"
9	19.40	"	9	19.10	"
10	20.10	"	10	19.10	"
Average	19.92	"	Average	19.21	"

It can be seen from the above figures that there is a visible, appreciable gain, in every way, of the progeny of the large over the small seed, in per cent of vegetation, rapidity of development of plant, yield of grain and straw and weight of seed. This experiment simply illustrates the wisdom of planting selected seed.

VEGETATION OF OATS AT DIFFERENT DEPTHS.

On May 6, a piece of ground well adapted to oats, being of clayey loam and very level in surface, was thoroughly pulverized and then carefully smoothed over and compacted on the surface. Ten rows were planted, each being twelve inches apart; the seeds were four inches apart in the row. By means of an instrument that could be registered to penetrate the ground at various depths forcing the seed along on its point, 1,000 seeds of oats were planted, there being 100 grains in a row. The following are the depths planted: One-fourth, one-half, three-fourths, one, one and one-half, two, three, four, five and seven inches. After forcing the seed into its position, the hole was filled with the fine surrounding soil. The following table gives the results of these vegetations for eleven successive days, with the final results as counted on June 23, which also represents the percentage of vegetation.

Number Vegetated at Dates Noted.

DEPTH PLANTED.	May 11.	May 12.	May 13.	May 14.	May 15.	May 16.	May 17.	May 18.	May 19.	May 20.	May 21.	May 23.	June 23.
$\frac{1}{4}$ inch	....	....	....	....	....	....	....	....	....	....	....	....	53
$\frac{1}{2}$ inch	....	....	....	....	....	....	....	....	....	....	....	....	88
$\frac{3}{4}$ inch	23	30	10	....	1	3	....	....	....	....	....	....	87
1 inch	82	7	1	....	....	....	1	....	....	....	2	....	94
1$\frac{1}{2}$ inch	89	7	....	1	....	....	....	1	....	....	....	....	98
2 inches	66	26	1	....	....	1	....	....	....	....	....	....	94
3 inches	7	77	5	1	2	....	....	....	....	....	....	....	92
4 inches	....	23	60	4	1	6	....	....	....	....	....	....	94
5 inches	....	....	37	32	12	11	....	....	....	1	....	....	83
7 inches	....	....	2	1	6	21	20	15	1	2	2	....	70

On May 11 the one and one-half inch depth vegetated 89, the greatest number of any depth, and it is be noted that on June 23 this depth showed the largest percentage of vegetation, one month after the last count made in May. When these seeds were planted the soil was quite dry, owing to the small amount of rainfall which occurred in April and May. The two rows with seeds at one-fourth and one-half inch did not vegetate for over three weeks, the surface soil was so dry. When counted on June 23 the percentage of vegetation was very low for one-fourth inch, and quite low for one-half inch. These two rows were very backward all the season, and did not mature and ripen seeds with those planted at greater depth; neither did they attain the height and robustness of the plants in the other rows. On August 3 the seedings from three-fourths to five inches were much in advance of the others, although when cut those planted at a depth of seven inches were not very tardy in development.

As with similar experiments conducted with wheat in 1885–6 at this station, one and one-half inch seems to be the most suitable depth at which to plant oats, in order to secure permanent moisture to insure early vegetation. On dry ground, or during a dry season, the ill effects from broadcast seeding can be well illustrated from the growths made at one-fourth and one-half inch in this experiment.

FALL PLANTING OF OATS.

On September 30, 1886, seventeen varieties of oats were planted, with the purpose in view of learning if any of these would withstand the severity of our northern winter. The winter oat is commonly known in the Middle or Southern States, where the severity of the winter is not sufficient to kill the plant after a good vegetation has taken place. Of the following named oats, thirteen are distinctly so-called winter varieties, being specially adapted to southern latitudes, the others being common to the North. The winter varieties made a very good growth, throwing out an abundance of fine, grassy leaves which matted close to the ground. The other varieties made the customary rather erect growth, with a medium amount of coarse foliage. These plants did very well until winter set in, and became covered with snow. By spring, however, each and every plant of all varieties was dead and brown. Not one had survived the cold and freezing and thawing. The following are the so-called varieties planted:

1, Burt's Extra Early Rust Proof; 2, Georgian; 3, Georgia Red Rust Proof; 4, Grazing; 5, Harris; 6, Mammoth Russian; 7, Milliard's Kansas Hybrid; 8, Red Rust Proof; 9, Rousse Couronne; 10, Rust

Proof; 11, Virginia Winter; 12, Zonette; 13, Gray Houdon; 14, Longfellow; 15, Pringle's Hybridized Hulless; 16, White Australian; 17, White Russian.

WINTER SOWING OF OATS AND BARLEY.

Much has been written in the agricultural press during the past two years regarding sowing oats in winter on the snow where wheat had failed. This method was advocated as a means of securing a crop from ground that would otherwise rest idle.

On February 10, 1887, when the ground was generally covered with snow, with here and there bare patches exposed, a plat one-twentieth of an acre in area was sown to White Russian oats, partly on snow, partly on the soil. The seeding was quite generous. Another plat of the same dimensions near by, was sown to common two-rowed barley, in about the same proportions as the oats. After this date (February 10), snow fell to a more or less degree at intervals during sixteen days up to April 18, when the precipitation was steady all day from 10 A. M. till night. During the period between February 10 and May 1 the extremes of air temperature were 65° and 6.7° F. above zero.

As vegetation began its growth in spring, these two seedings began to develop, but the progress was slow and no advance in earliness was made over the ordinary seeding of grain later in the spring; in fact the plants were more tardy than were the early seedings made in 1886, as recorded on pages 130, 131, 132, of the report of this station for 1886. It was noted that a large percentage of the seed sown did not vegetate. As the season advanced the plants made a poor showing, and it was thought that they would give a very meagre yield. The latter part of June, however, the oats began to develop rapidly and soon made a very good appearance, as compared with those in the field. On July 21st, the barley, and on the 29th the oats were cut, and the resulting harvest gave the returns, expressed in round numbers, in the following table:

	Sown.	Harvested.	Yield grain, lbs.	Yield straw, lbs.	Rate per acre grain, bush.	Rate per acre straw, lbs.
Barley	Feb. 10	July 21	20	31	8	620
Oats	Feb. 10	July 29	72	126	45	2,530

While the barley yield is very inferior, it is better than no crop at all from land on which the crop first planted is lost. The oat yield is very good, and favorably compares with the average yields of most farms.

This experiment was tried on a broader scale on the farm, several acres being sown after the manner described above. Although the soil was the poorest, physically speaking, of any of the 125 acres of the station, this seeding did very well and gave a fair return in crop. The character of the soil of the plat is clayey loam, which is easily worked; that where planted on the farm was a hard, compact clay not underdrained. Where the ground was quite moist (not wet), the oats did very well, but on the knolls rather poorly, as would have any grain planted in the ordinary manner.

There need be no hesitation on the part of the farmer to sow either oats or barley in late winter or early spring on ground where some fall-sown crop has made a failure. The risk is little, and the chance for a gain through the medium of their crop is very great.

EVAPORATION OF MOISTURE IN CONVERTING GRASS TO HAY.

From a piece of grass, consisting mostly of Meadow Fescue (*Festuca pratensis*), with a little Red Clover (*Trifolium pratensis*), two lots of 200 pounds each were selected. This grass was very even as growing in the field, and was cut by the mowing machine. Both lots were spread as in ordinary haying, covering an area of twenty by twenty feet, with a very good exposure to sunshine. It was a typical hay-day, with a light breeze blowing. The first weighing of the grass was made at 8 A. M., June 14, immediately after cutting, and thereafter every hour until 6 P. M. The grass was carefully raked up and weighed, and immediately after respread. The following are the figures secured, that for 7 A. M. being the weight of the hay in the cock the next morning at that time. At 6 P. M. of the first day the hay was cocked up, and the experiment was carried no further the next day than to weigh at 7 A. M.:

HOUR WEIGHED.	Weight of lot I, lbs.	Weight of lot II, lbs.	Difference in weight between lots I, and II, lbs.
8 A. M.	200.00	200.00	....
9 A. M.	172.50	180.50	8.00
10 A. M.	157.00	166.50	9.50
11 A. M.	137.25	147.50	10.25
12 M.	125.25	130.50	5.00
1 P. M.	106.25	116.25	10.00
2 P. M.	94.00	103.00	9.00
3 P. M.	87.75	95.50	7.75
4 P. M.	83.00	88.25	5.25
5 P. M.	78.87	87.00	9.00
6 P. M.	74.75	83.50	8.75
7 A. M.	76.25	84.75	8.50

Admitting that this experiment was conducted on a day when the meteorological conditions were most favorable for hay-making, we find that the greatest loss in moisture occurred between 8 A. M. and 2 P. M., after which the percentage of loss diminished to a slight extent. It is a striking fact that one lot lost over fifty per cent in the same time. Finally lot I lost 62.68 per cent in weight, and II, 58.25 per cent. The weather conditions were so favorable that the one day's drying sufficed, leaving it in suitable condition for storing in the barn.

FORAGE CROPS — ALFALFA (*Medicago sativum*).

In the report of the First Assistant for 1886, on pages 135 and 136, is given the record for that year of the Alfalfa crop grown at the station. The following brief notes are given as supplementary to the ones of 1886:

On May 7 the plants had reached a height of eight inches, and were making a strong, healthy growth. One week later the plants were nearly twelve inches high as an average, and presented a fine appearance. This growth continued strong and healthy, with an abundance of foliage, so that by May 30, when the plants were cut, they had an average height of two feet in A gore, while in one small plat of 100 square feet the average height was two and one-half feet. Four crops were cut during the season, leaving a splendid aftermath for grazing. The weights of the crops were as follows:

May 30, yield at rate of 14,525 pounds green fodder per acre.
July 7, yield at rate of 2,030 pounds dry fodder per acre.
August 3, yield at rate of 10,897 pounds green fodder per acre.
September 5, yield at rate of 8,487 pounds green fodder per acre.

Excepting in the yield of dry fodder, the difference in yield is not material. In this case the Alfalfa hay of 1886 was made from the largest crop, the one first cut; hence the weight of hay would in consequence be smaller. It is a noticeable fact that with each succeeding growth, the plants assume a tendency to blossom earlier than the preceding crop, without attaining its height. The plants also become woody earlier. Whether for hay or green fodder, this plant should always be cut before it becomes woody and tough. The cows, for some unexplained reason, have not eaten Alfalfa this year as greedily as common, and in one case, when considerable grown in a young orchard was allowed to bloom and become a trifle woody, the cattle would not eat it at all well.

One-half acre of Alfalfa was sown on the farm, on May 17, in a clay-loam soil, in the same manner as clover is planted. A very good vegetation was secured, much better than in an adjoining sowing of

Hungarian grass. At the present time this station has about two acres of ground devoted to Alfalfa, and, although it may be fairly stated that the seed is expensive, and large vegetations not certain after sowing, the five years' experience, as grown here, certainly indicates, if not proves, that Alfalfa will thrive and do well in this climate, and where good seedings are secured will yield a large, valuable crop, especially during dry weather.

PRICKLY COMFREY.

At Clifton Springs, N. Y., Dr. Henry Foster maintains a very large dairy farm. For several years he has grown prickly comfrey and fed it to his cattle in large quantity. At the time when I made my visit to his farm, sixty head of Holstein-Frisian grades were receiving two feedings a day of this fodder, in addition to two other feedings of corn ensilage. Dr. Foster assured me that his cows preferred this plant to any other green fodder he could supply them with. Very generally speaking, this plant has not been successfully used as fodder in America, yet there was a case in which a practical feeder used this plant largely as the most economical and desirable fodder present.

Securing settings from Dr. Foster on April 30, about one-twentieth of an acre of heavy clay-loam was planted in rows three feet apart, with roots one foot apart, in half of the rows, and two feet apart in the others. Although the weather was very dry for the month of May, the plants came on and grew at a remarkable rate, so that in less than four weeks a portion of the plants had to be cut back, owing to the plants coming to flowering. On June 6 some of the plants were a foot high, and at that time all were cut back to within three or four leaf buds from the ground. By July 11 the plants had grown to such an extent as to furnish a large yield of foliage, so that it was cut and offered to six cows. The comfrey was first placed in the mangers; it was scarcely touched. Corn meal was then sprinkled upon it, and while the cows ate the fodder better, they rather preferred to brush off the meal and lick it from the bottom of the mangers. Water was then sprinkled upon the plants, and meal dusted over them, but the cows still refused to eat to any extent. As a last resource, salt was scattered over the mangers, and the animals were thus induced to eat the fodder. Of the six cows, four evinced no special liking for it, while two apparently ate it with great relish. After eating all the comfrey in their mangers they were fed that left by the other cows, which they greedily ate. Later, the balance of the comfrey was fed to these two cows, of which they ate every leaf unprepared in any way. On September 27 the plants were again cut back, and the fodder given to the cows. It is an interesting fact, and confirms Dr. Foster's experience, that, before this last cutting was gone, all of the cows ate prickly comfrey with a relish, and four of them voraciously. The last cutting of fodder was given the cows as drawn from the plat, without addition of salt or meal.

ENSILAGE.

During the summer of 1887, the station received from Mr. James Wood of Mt. Kisco, Westchester county, N. Y., an apparatus imported from England, which is used there for the purpose of compressing open air silos. This instrument, which is in many respects like that used in compressing hay, is described as follows by the manufacturers. The description is accompanied by an illustration in the pamphlet which adds to its clearness: "The foregoing illustration of an open air stack of ensilage under pressure, shows the arrangement of poles or bars under and across the top of the stack, and chains which are looped around the projecting ends of the poles or bars. The gear as shown is fully extended, and has a ring on the upper bar into which the hook on the lever fits. The lever is shown attached to the gear, and ready for pressing down; this lever is only hooked into the ring on the upper bar of the gear, and a bolt regulated by a spring lever attached to the handle of the lever passes through the forked ends of the lever and the lower perforated bar of the gear, keeping all fast while pressure is being applied. When the lever is first pressed downwards a spring pawl attached to the upper bar of the gear is forced out of its position — where it has been keeping the strain tight — but when the lever is fully pressed down this pawl is immediately forced into position again at the next hole in the bars by the action of the spring, thus keeping the pressure secure from hole to hole, and allowing the lever to be unhooked from the gear for use elsewhere at any time. The gear consists of parallel flat bars working in slats."

On August twenty-fifth the construction of our silage stack in the open air was begun. Three stringers four by four inches were first laid level, with stones of good size placed beneath them to prevent sagging of the beams. Across these were placed two-inch planks, leaving spaces of a few inches between each. The area intended for the stack was placed at ten by ten feet. The stringers projected some distance beyond the area referred to, in order to allow the passage of the chains over them, and to furnish additional space if necessary for building out the stack. The foundation was begun on a very slight hillside, but not enough so to allow of a level placing of the stringers without digging slightly into the ground. This afterwards proved to be undesirable, as the weight of the fodder placed in the stack was so great as to bend the beams, especially where the greatest space beneath stack and ground occurred. Further, when great pressure was brought to bear upon the beams, they did not endure the strain as well as was expected, and would have broken off had not a cross stringer been placed beneath them, around which the chains were passed. The south end of the stack was elevated twelve inches above the surface of the ground.

Before the fodder was placed on the platform, a layer of straw about eight inches deep was scattered evenly over it. In the afternoon of August 25, timothy grass was placed to the extent of 1,889 lbs. upon the platform. On the twenty-sixth, well ripened Alfalfa was thrown on the timothy, 2,723 lbs. being placed over it, and additional to this, 7,500 lbs. of Hungarian grass that had passed the bloom into the milk state. The Alfalfa was considerably wilted, while the timothy and Hungarian were quite fresh. The next day, August 27, the stack was completed by adding 1,800 lbs. more of Hungarian grass, and 5,865 lbs. of timothy, orchard, lawn and such other grasses as could be secured upon the place. The stack at this time had reached a height of eight feet, with other dimensions of fourteen feet, and contained 19,777 lbs. of green stuff, all of the available grass at hand.

After giving the sides of the stack a thorough raking down, planks, as at the bottom, were laid over the top of the stack, and across these three more stringers of the same size as the others were placed, and over which medium-sized cable chains ten feet long were passed. One end of the chain should have a strong two-inch ring, and the other end a grab-hook. Over the opposite ends of the stringers were placed chains to which the hooks of the gear could be attached. Connecting the lever with the gear, the beams were brought under pressure gradually from opposite ends, and thus the stack was compressed. But the cross-beams were found to be too slender, so that six by six ones were obtained, and these found to be none too large. The most desirable cross-timbers would be of tough stringers from the forest, with one side hewn flat.

While no temperatures were taken of the degree of heat in the stack, it was noted that within a week the contents were exceedingly hot, and rapidly settled, finally lowering to a height of four and one-half feet. On September 30 the silo was cut into for a distance of about five feet from the south side, and to the bottom planks. At the top the ensilage was decayed from six to twelve inches in depth, not being rotten or offensive in the general acceptance of the term, but much discolored, and rather dry. The greatest loss came from the sides, which were spoiled for about twenty-four inches; on the under side the ensilage was decayed from two to six inches. Otherwise the contents were found to be in very satisfactory condition. There was almost no discernible acidity present, and the ensilage was the sweetest and most wholesome yet made at this station, or yet seen by the writer. When the silo was cut into, it was hardly warm — not enough so to cause comment. As fed to six cows the silage was well relished, even though the animals were having green fodder fresh cut every day, and was eaten with avidity.

Had there been enough available fodder so that this stack could have been built to a height of fourteen or sixteen feet, probably the loss would have been much less from decay. Occasionally mouldy spots of no special consequence were found, and this was especially true where the Alfalfa, and an occasional cornstalk occurred.

The general condition of the contents of this stock indicate that no injury would come to the fodder through exposure to the cold of winter.

REPORT OF THE HORTICULTURIST.*

Synopsis of Work Reported.

A test of varieties of the potato, with a report of experiments.
Experiments in root growth.
Notes on insects and insecticides.
Applications for the prevention of apple scab.
A study of the movements of soil water.
A description of varieties with classification, lists of synonyms and bibliography of various vegetables.

THE POTATO.

Under this head is reported:

1. A test of varieties.
2. Test with seed tubers selected from the most productive, and least productive hills.
3. Cuttings *versus* whole tubers of the same weight.
4. Fresh *versus* partially dried cuttings.

A Test of Varieties.

Twenty-six varieties or seedlings of the potato, of which the names and yields are given in the table on the following page, were grown the past season for the first time. Succeeding this table is a more elaborate one showing the result of a comparative test of seed tubers taken from productive and unproductive hills. This table serves equally well as a test of the varieties grown in 1886, of which it offers the results of two to four duplicate plantings of each, the four columns immediately succeeding the name showing the yield from the largest tuber of the most productive hill produced by each variety in 1886. The seed used in all was single eyes, planted April 26 to 28, in rows three and a half feet apart, the eyes placed one foot apart in the row. The soil, a fertile clay loam, received a good dressing of stable manure, which was applied and plowed in in the fall previous, and just before planting, was plowed very shallow, so as not to raise the manure to the surface. All after cultivation was done by hand. The season proved very dry until about midsummer, when abundant rains fell. In consequence, the potatoes made a slow and stunted growth through May and June, and some varieties matured before the drought was relieved. After the rains of July, those still alive commenced a vigorous second growth, that was checked in many cases only by frosts in October. On this account, the date of dying of the tops of the different varieties is not noted, and in order to simplify the table as far as possible, the data heretofore given of the time of vegetation, bloom, etc., though noted as usual, is omitted. The crop was harvested October 15 to 18.

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* E. S. Goff.

As in previous reports, the yields given in the table are calculated on the basis of 100 hills, or eyes. That is to say, the largest tuber of the Adirondack, of which six eyes were planted, would have produced 50 lbs. of merchantable tubers, had there been 100 eyes yielding at the same rate. This is done in order that all the plantings, in which the number of eyes used varied from four to twenty-eight, as well the plantings of different seasons, may be comparable with each other. The average yield, per hundred eyes, of the product of the largest tuber, in all the varieties, was 164 merchantable tubers, weighing 62 lbs. 1¾ oz., or a total yield of 701 tubers, weighing 98 lbs. 1½ oz. Calculated per acre, allowing every eye to have grown, and 60 lbs. to the bushel, the average yield of merchantable potatoes would have been a fraction more than 129 bushels.

It appears that the Green Mountain yielded most, or a little more than 385 bushels of merchantable tubers per acre, and the Grange second, or about 310½ bushels per acre. In contrast with these, Brownell's No. 55, Buffalo Bill and Crane's Keeper yielded no merchantable tubers.

Potato — A Test of Varieties.

NAME.	Number of merchantable tubers.	Weight of merchantable tubers.		Total number.	Total Weight.	
		lbs.	oz.		lbs.	oz.
Brown Beauty	43	7	14¼	391	32	1
Canada Prince Albert	123	31	11¼	987	84	11¾
Crane's June Eating	78	21	12¾	645	65	1
Crane's Keeper	None.	......	....	414	30	11
Crown Jewel	59	15	5½	500	55	5¼
Dakota White	177	53	14½	1,241	128	4¼
Early Puritan, or No. 49	9	2	11¼	536	25	0
Hovey's Advance	36	10	4¾	286	31	3½
King's Excelsior	164	68	7½	745	124	8
Lake Erie	277	113	5¾	727	160	10½
Lombard	277	97	8¼	882	139	6¾
Morrell's Seedling	173	50	4½	845	109	12¾
Norway Mountain Rose	41	12	10¼	491	46	1½
Nye's Early Standard	91	26	10½	577	59	8¼
Perfect Peachblow	110	37	13¾	819	99	5¼
Polaris	77	19	9¾	395	44	14¼
Sibley's Monroe County Prize	273	142	9¾	659	173	12¾
Summit	209	80	9¾	905	139	9
Sunlit Star	191	44	13	759	90	5½
Sylvan	214	84	15	623	127	10
Tunxis	236	96	¼	809	141	8¾
White Beauty	305	130	3	1,050	196	8¼
White Bermuda	218	85	4¾	945	133	6
White Flower	236	96	7¼	732	140	12¼
Yosemite	132	39	13½	814	98	4¾
"No. 49"	145	46	9½	736	101	6¾
Total	1886	704	9	7,373	1,168	7¼

NAME.	FROM THE MOST PRODUCTIVE HILL.								FROM THE LEAST PRODUCTIVE HILL.							
	LARGEST TUBER.				SMALLEST TUBER.				LARGEST TUBER.				SMALLEST TUBER.			
	Number merchantable.	Weight of merchantable.	Total number	Total weight.	Number merchantable.	Weight of merchantable.	Total number	Total weight.	Number merchantable.	Weight of merchantable.	Total number	Total weight.	Number merchantable.	Weight of merchantable.	Total number	Total weight.
		lbs. oz.		lbs. oz.		lbs. oz.		lbs. oz.		lbs. oz.		lbs. oz.		lbs. oz.		lbs. oz.
Adirondack	183	50 0	917	110 6½	150	59 6	1,117	147 6¼	None.	....	444	36 1¾	......	....	......	....
Alexander's No. 103	208	129 12	581	159 8¾	300	172 10½	550	184 10¼	71	16 1¼	386	42 10¼	......	....	......	....
Alexander's Prolific Montreal	221	88 11½	1,371	172 7	288	147 9¾	1,367	187 12¼	144	49 5	1,222	129 8¼	......	....	......	....
American	257	85 7¾	1,243	138 13¼	237	90 3¼	612	112 4¾	289	106 12¼	733	137 13½	......	....	......	....
American Giant	225	86 14	855	139 6	250	100 10	800	141 9½	211	75 0	633	106 1¼	......	....	......	....
Andrus White Rose	236	127 13	654	130 14½	260	162 8	467	175 5	320	166 9	1,320	207 3	......	....	......	....
Arundel Rose	179	59 2½	607	90 4¼	256	103 2	937	141 ¼	254	90 15¾	854	139 1	......	....	......	....
Astonisher	200	73 14¾	669	118 15¾	157	66 1¼	371	82 9½	194	61 13	431	83 3¼	180	67 ½	520	93 14¼
Baker's Imperial	280	138 10¾	705	177 6¾	191	108 8½	445	134 8¼	188	67 7½	588	106 14¾	200	88 3	600	119 13¼
Baraboo White	33	7 7	248	21 15¼	None.	....	257	15 6½	None.	....	367	11 15¾	None.	....	266	9 6
Beauty of Hebron	50	12 ¾	736	47 14¾	67	24 2¼	367	47 3½	70	19 6	490	43 12	......	....	......	....
Big Benefit	119	19 14¼	509	37 3½	120	29 11	350	39 1	129	29 7½	614	38 13½	......	....	......	....
Bliss's No. 12	146	25 7¾	777	71 12	62	14 13½	612	50 6¼	14	3 12¾	514	31 14¾	None.	....	350	20 13¼
Boston Market	67	16 9¼	561	48 8½	91	22 11¾	536	50 2¼	87	25 6¼	712	49 13	71	19 10¼	800	61 9¾
Breese's Red	235	108 13¾	625	147 9¼	275	123 13	925	179 11	......	....	......	....	......	....	......	....
Brownell's No. 55	None.	....	367	30 11¾	300	131 1¾	1,400	200 6¼	None.	....	525	38 7¼	57	13 9¾	571	49 1¾
Buffalo Bill	None.	....	220	8 13¾	......	....	......	....	71	17 13¾	379	42 13¾	......	....	......	....
Burbank	331	138 10	624	163 11	323	172 ..	577	198 5	282	157 13	609	183 10¾	......	....	......	....
Burpee's Empire State	284	123 4	740	161 6½	250	130 4¼	750	161 14¾	173	87 3½	936	123 9¼	243	104 ¼	1,200	157 3¾
Charles Downing	100	14 11	410	34 6	50	7 13	300	23 11¼	89	14 1	287	27 11¾	100	20 1½	300	31 ½
Charter Oak	73	16 11¼	409	45 5	60	16 4	530	52 8	None.	....	556	35 12¼	......	....	......	....
Chicago Market	158	46 1½	729	85 14	147	40 5	627	69 12¾	237	75 12½	636	102 8¾	......	....	......	....
Clark's No. 1	214	85 1¾	864	123 5¼	212	84 7½	587	104 11	111	60 12¼	622	105 ½	......	....	......	....
Conqueror	113	37 4¾	266	54 2¾	130	36 9	430	55 5	None.	....	200	2 9¾	......	....	......	....
Corless Matchless	165	58 14¾	741	104 8	246	87 6	677	118 2¼	209	96 ¼	973	151 4½	250	48 14½	470	65 0
Crandall's Seedling	43	10 6¾	707	58 15	109	30 7¼	782	73 2½	20	4 6	370	16 11½	......	....	......	....
Crane's Potentate	100	38 4½	540	80 ..	91	27 6¾	600	66 10	157	57 6	500	80 12¾	......	....	......	....
Dakota Red	286	97 3¼	721	139 10	......	....	......	....	60	17 ½	270	31 6½	266	160 15	522	188 14¼
Defiance	129	32 10¾	843	95 15¾	117	29 11	817	92 11½	133	44 12¾	1,133	186 7¼	......	....	......	....
Dunmore	292	112 1¾	642	142 13½	175	73 14¼	675	106 ¾	......	....	......	....	......	....	......	....
Early Albino	136	37 14¾	518	65 7¾	100	30 9	555	61 1¾	82	23 4¾	518	61 3½	......	....	......	....

Early Dawn	284	134	10	763	179	12¼	260	109	12¾	627	143	7	282	93	0¾	664	133	3¾	345	135	6	864	181	8½
Early Dunham	150	31	5½	606	56	5½	150	34	6	521	51	5½	137	43	12	662	71	1½	142	37	4½	1,129	73	7
Early Eclipse	276	85	4	892	127	11	186	83	4	543	113	13½	229	38	13½	729	55	12	None.	......		240	14	1
Early Mayflower	111	35	12¼	722	75	0	160	38	7	560	73	7	87	17	9¼	425	43	9	80	24	11	940	69	1
Early Modena	262	99	12	1,269	173	12¾	233	92	11¼	1,133	165	5¾	133	44	8	955	101	11¾	67	22	2¼	700	80	11¾
Early New Zealand	112	36	5¼	369	53	2	80	20	3¼	367	40	3¼	44	8	8	255	24	7¾	......	......		......	......	
Early Ohio	50	13	12¼	362	37	11¼	14	5	8¾	429	33	14¾	None.	......		500	29	4¾	......	......		......	......	
Early Rose	57	23	10½	507	59	6	29	10	15	1,186	45	8¾	111	31	12¼	422	61	10	80	19	11	700	69	1
Early Snowflake	73	22	0¼	1,055	78	15¾	86	21	10½	614	60	11½	112	31	13¼	612	63	13¾	50	10	15	900	45	5
Early Sunrise	133	42	11¼	992	99	7¾	131	39	6¾	631	88	15	100	32	3	1,050	84	8½	117	41	10¾	733	89	5¼
Early Telephone	150	55	13¾	725	97	13¾	125	45	8	750	69	8½	117	29	11	1,067	91	10¾	100	23	13¼	675	54	11
Early Vermont	280	110	11¾	833	157	3	200	81	8½	736	135	12¾	191	68	12	800	115	3	......	......		......	......	
English Champion	210	75	5	1,140	122	10½	78	22	6¼	678	66	2¼	178	56	4	1,278	109	8¾	200	66	4	680	98	2
Farmers' Favorite	364	172	11¾	700	207	1¾	300	173	12	770	229	3½	None.	......		400	19	14¾	......	......		......	......	
Finch's Early Perfect'n	224	90	8¾	733	126	0¾	225	95	14¼	737	148	0¾	173	61	8	900	101	6¾	136	51	0	800	105	6¼
First and Best	180	51	2	900	99	1	......	......		......	......		120	34	11	610	67	8	......	......		......	......	
Garnet Chili	133	53	6¼	683	91	14¾	100	4	11	400	5	12½	......	......		......	......		......	......		......	......	
General Logan	308	150	2	1,575	205	5½	250	137	8	737	167	6	300	39	11	740	74	11	......	......		......	......	
General McClellan	227	93	12	800	132	13	243	88	15¼	650	114	8	125	39	4	312	46	1½	......	......		......	......	
Giant Osceola	243	76	1¾	643	102	14½	157	42	4¼	571	72	5¼	186	65	0	614	95	12	......	......		......	......	
Grange	300	174	3½	1,186	223	7	312	190	10	1,237	247	10½	245	139	15½	1,409	207	13	217	98	11¼	883	134	6
Green Mountain	341	185	6¼	835	227	15	340	190	12½	750	230	15	300	162	8	500	181	6¾	312	162	11	1,237	226	5¾
Gypsy	136	58	8¼	327	79	13¼	190	92	0½	470	117	10½	83	37	12¼	583	68	7¾	......	......		......	......	
Hampden Beauty	164	53	2	693	92	10¼	129	33	11¼	829	71	6¾	122	29	5½	456	52	4¼	......	......		......	......	
Intermediate	27	6	13	582	35	3¾	......	......		......	......		10	3	7	250	19	3½	......	......		......	......	
Invincible	255	117	3	609	143	7½	200	91	10¾	500	117	3	150	66	12¾	1,000	125	0	......	......		......	......	
James G. Blaine	106	33	9½	669	75	14	109	31	15½	855	70	11¾	173	55	8½	845	92	3	86	22	5¼	571	50	10¾
James Vick	264	118	6¾	714	160	0¾	273	133	6	691	173	13¾	170	68	14½	680	121	1½	300	128	6¼	733	163	0¼
Jumbo	153	53	7	627	88	10¼	85	22	13½	608	57	1½	111	45	5	667	88	3	......	......		......	......	
Keystone	269	121	10¼	1,062	179	3¼	273	124	0	673	160	6	200	92	6½	786	151	5½	200	73	2¾	933	106	4
Late Beauty of Hebron	286	41	15½	786	71	14	120	18	2	310	28	3	27	3	2	218	8	8¼	None.	......		162	18	5¾
Late Strawberry	121	43	10¼	371	62	6¼	180	46	9	340	57	8	......	......		......	......		......	......		......	......	
Luxury	15	4	11	562	28	2	50	13	11	779	45	6¾	33	9	6	733	32	4¾	None.	......		240	15	10
Magnum Bonum	162	49	6¾	625	92	12¼	162	58	8¼	575	87	8	83	21	5¾	366	43	7¾	......	......		......	......	
Mammoth Pearl	126	78	4	700	112	6	191	71	9½	482	102	6¾	240	148	7	660	170	5	......	......		......	......	
Marvel of Beauty	117	22	0	283	30	1¼	83	14	1	358	24	14	None.	......		260	7	8	......	......		......	......	
Monitor	160	52	9¾	733	99	4¼	190	65	0	590	99	8½	282	101	15¾	527	124	0	200	58	13¾	489	79	13¾
Morning Star	233	90	11¼	679	130	6¾	218	74	11½	727	129	2	237	82	13	569	116	0¼	......	......		......	......	
Mountain Rose	71	10	4¼	271	19	3¼	None.	......		117	5	11¾	None.	......		187	10	8¾	None.	......		200	12	2¼
New Champion	202	113	7	484	138	7	271	110	0¾	846	130	9¼	293	125	3½	486	147	8¾	200	84	3	412	109	12¼
New England Beauty	87	25	9½	500	65	0¾	129	34	9½	571	68	8½	None.	......		183	8	1¼	......	......		......	......	
New Queen	153	48	13¾	573	80	15	131	35	13	585	51	14¾	114	37	11½	486	66	1¼	143	49	8¾	486	71	6¾
Nott's Victor	155	52	1	623	93	1¾	150	61	3¼	550	100	0½	156	51	9	511	83	5¼	120	35	5	560	59	1
"No. 88"	300	118	7	880	165	1¾	233	116	12¼	867	171	11¼	173	53	8¾	718	100	0	200	102	1¼	567	137	8
O. K. Mammoth	231	103	7¾	677	147	5¾	277	132	13	615	154	2½	180	89	1	500	109	6	......	......		......	......	
Oswego Wonder	209	85	15	591	118	0¾	190	106	11½	680	152	8	200	112	8	600	140	5¾	......	......		......	......	
Pearl of Savoy	106	33	3¾	575	75	1½	89	24	13¼	400	47	14¾	87	25	9½	825	58	9½	125	39	1	875	85	2½
Pecan	231	62	13¾	1,300	123	5	271	68	5¼	871	106	7½	211	71	11¼	1,200	145	10½	167	45	0¾	1,233	110	15
Pennsylvania Belle	179	66	11¾	657	101	14¼	122	40	10	400	63	3	210	88	4½	370	104	1	......	......		......	......	
Pride of America	30	7	5½	510	43	7	22	6	1¼	322	16	5	None.	......		620	38	12	......	......		......	......	

NAME.	FROM THE MOST PRODUCTIVE HILL.								FROM THE LEAST PRODUCTIVE HILL.							
	LARGEST TUBER.				SMALLEST TUBER.				LARGEST TUBER.				SMALLEST TUBER.			
	Number Merchant'ble.	Weight of Merchant'ble.	Total number	Total weight.	Number Merchant'ble.	Weight of Merchant'ble.	Total number	Total weight.	Number Merchant'ble.	Weight of Merchant'ble.	Total number	Total weight.	Number Merchant'ble.	Weight of Merchant'ble.	Total number	Total weight.
		lbs. oz.		lbs. oz.		lbs. oz.		lbs. oz.		lbs. oz.		lbs. oz.		lbs. oz.		lbs. oz.
Putnam's Favorite	133	46 8½	1,189	130 3¼	150	48 9½	1,430	118 12	229	75 7¼	971	133 4	......	....	......	....
Rochester Favorite	242	118 14	725	174 2½	299	148 7	709	190 3¼	309	133 1½	918	187 14¾	327	140 12¼	736	170 14
Rocky Mountain Rose	75	20 12¾	512	50 7¾	50	15 14¼	583	58 5¼	67	14 13½	350	46 5¾	......	....	......	....
Rogers' No. 4	177	63 13¼	530	93 10	17	11 3¼	317	21 9¾	67	25 11	344	43 3¾	......	....	......	....
Rogers' No. 7	237	144 7	1,181	209 7½	400	166 0¼	2,025	242 9¼	322	129 5½	1,189	193 9¼	......	....	......	....
Rose's New Seedling	133	39 13½	1,017	94 4¼	114	37 15¼	700	81 ½	280	91 9	900	129 1	......	....	......	....
Rose's No. 74	205	87 3	880	132 1¾	236	89 10	709	124 11½	154	58 2¾	846	109 15½	......	....	......	....
Rose's "Wild" Potato	156	59 11½	628	101 4¾	100	45 10	520	81 9	......	....	......	....	......	....	......	....
Rosy Morn	165	37 6¾	1,040	95 7½	186	53 12¾	729	90 6½	......	....	......	....	......	....	......	....
Rubicund	50	15 6½	364	41 13	......	....	......	....	44	11 4½	444	35 6¾	......	....	......	....
Rural Blush	300	125 6¾	1,136	193 ½	......	90 3¾	......	139 4	383	183 13¾	1,058	238 10¾	260	155 7½	530	185 12½
Rural Buttercup	78	25 14	544	57 9¼	50	15 ½	412	45 2	40	10 5	300	29 6	......	....	......	....
Saint Patrick	173	62 4¼	612	105 12½	187	79 7¾	713	129 14¼	None	....	328	12 10¾	......	....	......	....
Scottish Champion	57	13 9¾	329	36 ¾	36	8 6	418	36 8	55	14 14¾	345	36 8	......	....	......	....
Snow Queen	44	10 15	689	60 15	50	16 6½	600	54 7¾	None	....	217	5 9	......	....	......	....
Steele's Red	20	4 12¾	247	15 13¼	None	....	60	0 5	......	....	......	....	......	....	......	....
Thorburn	190	73 14½	615	109 12¼	64	26 0	382	60 1¼	55	16 7¾	473	51 0	100	27 11¾	500	62 14¼
Thunderbolt	294	84 0	1,465	232 2¾	233	111 3¼	1,450	178 10¼	333	120 13¼	1,233	198 15¼	250	140 5¾	1,133	222 6¼
Tyrian Purple	140	44 6	830	109 3½	200	58 0½	771	106 4	None	....	129	6 8¼	......	....	......	....
Vanguard	107	32 0½	671	75 7¼	130	46 4	500	77 15½	118	39 10	391	75 9	100	34 6	456	65 15½
Vermont Champion	20	5 0	190	21 11½	None	....	180	11 14	......	....	......	....	......	....	......	....
Vick's Extra Early	286	139 10	729	182 7¾	200	85 6	543	129 14½	162	72 13¾	412	98 10	......	....	......	....
Vick's Prize	18	4 8¾	582	38 3½	67	8 5¼	400	22 6¼	33	6 15	456	33 13¾	12	5 10¾	387	34 9¼
Walls' Orange	227	78 5¼	560	117 4¾	222	67 5¾	555	108 2½	211	88 0¼	589	129 0	......	....	......	....
Webb's Early	27	3 5¼	387	18 2	81	9 15½	381	22 2¾	56	15 15	433	47 6¼	57	16 15½	571	54 3¾
White Elephant	327	161 15¾	1,040	221 15¾	150	88 4½	867	140 14¼	237	132 0½	1,025	199 3½	250	130 15	810	182 13
White Star	228	108 13¾	572	148 2¾	275	131 13½	562	164 7¼	300	146 2½	785	190 3¾	244	124 2	789	176 14½
White Whipple	238	97 15¼	615	136 2¾	178	63 3	689	113 14¼	120	63 12	660	106 9	......	....	......	....
"X X"	109	9 15	555	25 0	18	4 4¼	255	28 11	43	10 11½	614	51 12½	None	....	480	32 8
Seedling:																
"Chance"	75	25 15¾	475	57 13	111	47 5¼	722	86 15¾	67	22 9¾	533	59 12¾	127	36 0¾	467	56 2¼
Robinson, No. 7	219	89 8¾	606	115 14¾	209	80 4	555	116 0¾	164	66 5¼	655	104 6½	......	....	......	....

Station No. 3.......	87	34 4½	506	76 5¾	86	28 12¾	214	38 3	143	44 12	407	68 15½	80	34 6	340	54 13½
Station No. 8.......	173	60 12¾	745	114 12¼	200	73 12½	700	124 13¼	200	62 8	657	101 1¾	100	37 8	700	83 11¼
Station No. 11......	178	85 7¾	600	123 7	155	78 15¾	236	103 13¼	145	61 1¼	564	106 13	200	69 12½	444	92 14
Station No. 12......	100	35 10¾	683	88 4½	133	46 1½	733	100 0	129	46 6¾	614	88 13½	75	25 12½	525	60 15
YIELDS CALCULATED ON THE BASIS OF 100 EYES:																
Average of 41 varieties, or seedlings, of which 4 tubers were planted	180	72 11¾	757	117 11	173	71 8¼	666	106 15½	166	64 2	694	104 11½	160	61 1½	704	98 12
Average of 42 varieties, or seedlings, of which 3 tubers were planted	183	73 1¾	735	112 0¼	177	72 2¼	664	106 8½	163	62 11	635	97 15¾	......	....	......	....
Average of 9 varieties grown in 1884	......	83.4	......	106 0	......	69 0	......	88 0	......	66 0	......	85 0	......	45 0	......	69 0
YIELDS CALCULATED PER EYE IN OUNCES:		oz.		oz.		oz.		oz.		oz.		oz.		oz.		oz.
Average of 2 varieties grown in 1886	......	11.43	......	11.57	......	15.85	......	13.06	......	13.51	......	14.30	......	4.14	......	4.36
Average of 10 plantings, (9 varieties) grown in 1885	......	17.24	......	23.08	......	16.77	......	21.92	......	15.53	......	20.45	......	11.67	......	17.07

TESTS WITH SEED TUBERS SELECTED FROM THE MOST PRODUCTIVE AND LEAST PRODUCTIVE HILLS.

Garden Tests.

In the year 1884 an experiment was commenced in the use of seed tubers selected with reference to the prolificacy of the hills that produced them, an experiment that has been continued up to the present season*. In this report is presented additional evidence upon the subject.

In the fall of 1886, the most productive and the least productive hill respectively, was selected from the yield of our entire list of varieties and seedlings of the potato, and last spring the largest and the smallest tuber from each of these selected hills, that contained more than one tuber, was cut to single eyes and planted by itself. In many cases the least productive hill contained but a single tuber. In others the smallest tuber was too small for cutting and was rejected, no tubers not large enough to make at least four single eye cuttings of fair size being planted.

In the preceding table is given the yields, calculated on the basis of 100 hills or eyes of 116 varieties and seedlings, and on the last page of this table is presented a summary, giving the average yield of all the varieties of which the conditions admit of comparison. Certain varieties produced no merchantable tubers in one or more of the plantings, while of others only two tubers were planted. Such irregular cases were not calculated in the averages.

The averages secured in previous trials in the same experiment, as published in the reports of 1884, 1885 and 1886, are also appended for comparison with those of the past season.

In considering the results of this experiment it should be remembered that the yields given are the yields per eye planted, and not per tuber planted. This eliminates in great measure the influence of size in the tubers, because the size of single eye cuttings bears no necessary relation to that of the tuber whence they come. In order to avoid confusion in the use of terms, the most productive hill is spoken of as A and the least productive hill as B.

From the averages given it appears that the largest tuber of A yielded most in every case; that the smallest tuber of the same yielded second; that the largest tuber of B yielded third, and the smallest tuber of the same, when such was planted, yielded least. This order, it will be observed, does not correspond with that of the size of the tubers, because the smallest tuber from A averaged decidedly smaller than the largest one from B.

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* See Reports New York Agricultural Experiment Station, 1884, pp. 301–305; 1885, pp. 204–207; 1886, pp. 150–151.

If we lay aside the exact numerical values and consider the yields only in terms of greater or less, it appears from the table that the merchantable yield of the largest tuber of A exceeded that of the largest tuber of B in sixty-nine cases, while the reverse was true in but thirty-eight cases; also that the yield of the smallest tuber of A exceeded that from the largest tuber of B in sixty-six cases, while the reverse was true in but thirty-five cases.

Plat Trials.

In addition to the garden tests just noted, six of the main plats, containing one-tenth acre each, were devoted to this same line of experiment, a quantity of seed having been selected for this purpose from the best and poorest hills of 1886. In order to avoid, as far as possible, the errors due to variation of soil in adjoining plats, each alternate row of these plats was planted with one selection of seed, and the remaining rows with the selection intended for comparison.

The soil was well prepared, but no fertilizer of any kind was used. The variety of potato was White Star, planted in rows 4 feet apart, the tubers or cuttings placed 1½ feet apart, in furrows 2½ inches deep, and covered with 2 hoefuls of dirt, the hill stepped on by the coverer. The surface soil was rather dry at the time of planting, and but .04 inch of rain fell for about 20 days thereafter.

Plats B 6 and 7 were planted May 3, with the largest tubers from the best and poorest hills of 1886, cut to single eyes. The crop was harvested October 8, and the yields were as follows:

	LARGEST TUBERS FR'M THE MOST PRODUCTIVE HILLS.			LARGEST TUBERS FR'M THE LEAST PRODUCTIVE HILLS.	
	Merch., lbs.	Total, lbs.		Merch., lbs.	Total, lbs.
B 6, Row 1	65¼	71¼	Row 2	68½	76½
3	79	86	4	87¾	93¾
5	92	101¾	6	69	77½
7	70¾	81¾	8	68¼	76
Aggregate	307	340¾	Aggregate	293½	323¾
B 7, Row 1	53¼	63¼	Row 2	51	60¼
3	55	67¾	4	60¾	70¾
5	59½	60½	6	60½	67¼
7	73½	81¼	8	59½	62½
Aggregate	241¼	272¾	Aggregate	231	260¾
Aggregate for the two plats	548¼	613½	Aggregate for the two plats	525	584½

In view of the extreme and entirely unaccountable variability in the product of different rows planted with the same seed, and the indecisiveness which always attends the plat system, the question naturally arises whether or not the comparison of aggregates is just. The tubers selected from the best hills were somewhat larger than those from the poorest, and the results of past experiments would lead us to expect a somewhat greater yield from the larger tubers. On the whole the results are favorable rather than otherwise to the most productive hills.

Plats 8 and 9 were planted May 3, with the smallest tubers from the best and poorest hills of 1886, not cut. The crop was harvested October 12, with the following results:

	SMALL'ST TUBERS FR'M THE MOST PRODUCTIVE HILLS.			SMALL'ST TUBERS FR'M THE LEAST PRODUCTIVE HILLS.	
	Merch'ble, lbs.	Total, lbs.		Merch'ble, lbs.	Total, lbs.
B 8, Row 1	91	103¼	Row 2	74¼	86
3	95¼	105¾	4	81	91¼
5	116	130	6	78	88½
7	96	112	8	61	73½
Aggregate	398¼	451¾	Aggregate	294¼	339¼
B 9, Row 1	56¼	73¼	Row 2	80¾	94¾
3	108½	124¼	4	97	197¼
5	109¾	120½	6	89	95¼
7	85	93¾	8	79½	87¼
Aggregate	359½	412	Aggregate	346¼	384½
Aggregate for the two plats	757¾	863¾	Aggregate for the two plats	640½	723¾

In this case the balance is decidedly more favorable to the most productive hills, especially in plat 8. The seed tubers from these hills were slightly larger on the average than those from the poorest, but I should not expect so great a difference in yield to come from this source alone.

In order to eliminate as far as possible the errors due to unequal size in the seed tubers, plats B 10 and 13 were planted May 3 with tubers from the best and poorest hills, of which the average weight was exactly the same. The required number of tubers was selected from the best hills of 1886, and weighed. The same number was then picked out from the poorest hills, and individual tubers were changed until the aggregate exactly equaled that of the selections from the best hills. The tubers were about the size of small hens' eggs, and were cut into halves from the stem to the terminal eye. B 10 was harvested October 12, and B 13 October 8. The yields were as follows:

	TUBERS FROM THE MOST PRODUCTIVE HILLS.			TUBERS FROM THE LEAST PRODUCTIVE HILLS.	
	Merch., lbs.	Total, lbs.		Merch., lbs.	Total, lbs.
B 10, Row 1	89¼	105¼	Row 2	87¼	104¼
3	97¾	119¾	4	117	136½
5	89½	108	6	80½	97½
7	82¾	102	8	83½	99¾
Aggregate	359¼	435	Aggregate	368¼	438
B 13, Row 1	132¼	146¾	Row 2	122½	139¼
3	140¼	155¼	4	131	151
5	130¼	149¾	6	119¼	136¼
7	123¼	139¼	8	114	134½
Aggregate	527	591	Aggregate	486¾	561
Aggregate for the two plats	886¼	1,026	Aggregate for the two plats	855	999

In B 10 the aggregate merchantable yield from the most productive hills is 9 lbs. less than that from the least productive, but in B 13 it exceeds the same by 40¼ lbs. The aggregate for the two plats shows an excess in favor of the most productive hills of 21¼ lbs. of merchantable, and 27 lbs. of total yield.

If we consider each two adjoining rows as one series, we have in the six plats twenty-four series, in each of which is one row planted with seed from the most productive and one from the least productive hills. Laying aside exact numerical values, and considering the yield only in terms of greater or less, which is about all that the plat system warrants, it appears that the merchantable yield of the row from the most productive hills exceeded in seventeen cases out of twenty-four.

From the data, it appears further that the greatest difference in the yields of any two rows planted with the same selection of seed was in the merchantable yields fifty-nine lbs.; in the total yields fifty lbs. The greatest difference in the yields of any two rows planted with different selections of seed was, merchantable fifty-five lbs., total fifty-six lbs. In other words, the differences in the yields of rows planted with the same selection of seed are on the average fully as great as in those planted with different selections. The plat trials therefore do not prove that the seed from the most productive hills was really more favorable to crop than that from the least productive hills. They do, however, give strong evidence in favor of the seed from the most productive hills.

When we consider the results of all the trials that have been made at the station in the use of seed tubers from productive and unproductive hills, reaching through the past four seasons, the evidence has been so uniformly in favor of the former that there can be no longer any doubt of the importance of this method of selecting seed. No computations intended to express the real increase in yield per acre that is likely to result from such selection are offered. It is sufficient if the experiment proves that this method of selecting seed tends to increased crop. It is reasonable to expect, though the trials do not prove it, that the gain in vigor would be cumulative — that is, that it would increase from year to year so long as the selection is practiced, or up to the limit of the variety. The results of this experiment at least offer hope that a remedy is available for the deterioration in productiveness of varieties of the potato.

CUTTINGS VERSUS WHOLE TUBERS OF THE SAME WEIGHT.

In the Station Report for 1886, pp. 151-153, is reported an experiment in the use of whole tubers, and cuttings of equal average weight, in which the yield appeared to favor the whole tubers. This experiment was repeated the last season on main plats B 14, 15 and 16. The first of these plats was planted in alternate rows with single eyes, and whole tubers of which the average weight was exactly the same as the cuttings. The second was planted with three eye cuttings and whole tubers of equal weight, and the third with half potatoes, and whole tubers of equal weight. The plats were planted May 3, and the crop was harvested October 7 and 8. The yields were as follows:

PLAT B 14.

	SINGLE EYES.		WHOLE TUBERS.	
	Merchantable	Total.	Merchantable	Total.
	96	108	78½	88
	102	112½	74¾	84¾
	98	113¼	79½	90¼
	74½	87¾	71¾	82½
Aggregate............	370½	421½	304½	345½
PLAT B 15.				
	83½	102	86	107¾
	83¾	102½	104¼	123¾
	103	124½	109¾	128½
	111½	126½	118¼	139¾
Aggregate............	381¾	455½	418¼	499¾
PLAT B 16.				
	106¼	128¼	111½	134½
	122¼	140½	127¾	151
	118	137	119¼	139
	107½	127¾	88¾	113¾
Aggregate............	454	533½	447¼	538¼

The results are entirely non-committal. In plat 14, the cutting appeared favorable to the yield; in 15, the reverse was the case, while in 16, the yields are as nearly equal as could be expected in duplicate plantings.

Fresh versus Partially Dried Cuttings.

In the Station Report for 1886, page 153, is given the result of a test with fresh cuttings compared with those exposed to the air for eleven days before planting, which appeared to indicate that the partial drying proved favorable to the yield.

The past season this test was repeated on a more extended scale. Beginning on Saturday, April 3, and continuing until Monday, May 2, a given number of single eye cuttings from White Star potatoes of good merchantable size were made on each week-day morning, and after being weighed, were spread over the bottom of a small box, which was then placed on the floor of the office attached to the green-house. The temperature of this office ranged from about 60° to 80°

F., and the dryness of the air was tempered somewhat by moisture from the greenhouse.

On May 2, each lot of cuttings was again weighed, to determine the loss of moisture, after which ninety-nine from each were planted, with an equal number of fresh cuttings. The test was made in nine duplicate series, each containing twenty-six rows and eleven hills or eyes in each row. The first row in each series was planted with fresh cuttings, the second with cuttings that had been exposed two days, the third with those exposed three days and so on.*

In the following table, the aggregate yield of the nine series is given as one series, *i. e.*, the yields of the first row in all the series are added together to form row No 1 of the table, and so on.

The second column of the table shows the per cent of loss in weight from evaporation during the exposure of the cuttings. As appears, this percentage did not always increase in proportion to the length of the exposure. The third column shows the number of eyes that vegetated out of ninety-nine planted. The four columns succeeding the third give the actual yields, and the four to the right the yields calculated on the basis of 100 hills. At the latter end of the table, the data of each five rows of the series (the first contains six rows), are averaged as one row.

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*As no cuttings were made on the five Sundays that intervened between April 2 and May 2, the number of days drying did not always correspond with the number of the row, as appears from the table.

POTATO — CUTTINGS DRIED TO VARIOUS DEGREES.

	Number of days exposed.	Per cent of loss.	Number of eyes that vegetated.	Number of merchantable tubers	Weight of merchantable tubers	Total number of tubers.	Total weight of tubers.	Calculated on the Basis of 100 Hills.			
								Number merchantable.	Weight of merchantable.	Total number.	Total weight.
Row No. 1	......	....	94	253	117 8¼	552	148 5	269	125 0¼	587	157 12½
2	2	8	99	238	95 13¼	539	126 12¼	240	96 12¾	544	128 0¾
3	3	16.3	97	220	95 15¾	448	123 11½	227	98 12¾	462	127 8½
4	4	17.2	99	301	149 10½	626	188 0¼	304	151 2¾	632	189 14½
5	5	23.6	97	225	92 13¾	469	119 0¼	232	95 11¼	484	122 11¼
6	6	19.7	99	274	122 10¼	520	147 15½	280	123 15¾	525	149 6
7	7	24.9	98	259	110 10½	602	147 8	264	112 14¾	614	150 9
8	9	26	96	272	128 4½	554	156 4½	283	133 10	567	162 12¾
9	10	29.1	93	285	116 7½	......	144 15½	306	125 3¾	......	155 14
10	11	31.2	91	239	104 13¾	540	132 1¼	263	115 3¾	593	145 2¼
11	12	28.9	97	264	112 13	557	139 1¾	272	116 4¾	575	143 6½
12	13	32.2	98	233	97 7¾	538	127 15½	238	101 8½	549	130 9¼
13	14	33.3	95	240	99 8¼	542	131 13¼	263	104 11½	568	138 2¼
14	16	39.9	84	228	93 3½	546	120 11¼	271	110 15½	840	143 11
15	17	38.8	86	227	99 0	527	128 10½	264	115 1¾	613	144 15¼
16	18	39.3	80	229	101 1¾	497	124 5¼	286	126 6¼	621	155 6½
17	19	41.8	76	212	100 5	458	125 14	279	131 15¾	603	164 9¼
18	20	36.1	83	209	95 9½	488	125 0¼	252	115 2¾	588	150 10
19	21	51.1	58	193	93 0¼	418	114 1	333	160 6	721	196 10½
20	23	44	64	169	79 12¾	407	99 15½	264	124 11	636	156 3¼
21	24	49	53	190	101 10	408	119 13¼	358	191 12	751	213 15¾
22	25	44.3	66	224	115 13½	475	142 12¼	340	175 8¼	705	216 5
23	26	47.8	60	181	89 2¼	365	108 9¼	302	148 9	608	180 15½
24	27	45.6	56	167	73 11¼	339	90 6¾	298	131 9¾	605	161 7½
25	28	52.6	53	149	69 7¼	297	84 11½	281	131 1	560	159 13½
26	30	38.4	58	190	83 9¾	385	100 2¼	328	144 2½	664	172 10½
Average of rows Nos. 1–6	3.3	14.13	97.5	252	112 6¾	525.67	142 4¾	259	115 7¼	539	145 14¼
7–11	9.8	28.02	95	263.8	114 9¾	560.75	143 15¾	278	120 10¾	587	151 9
11–16	15.6	36.4	88.6	231.5	98 7½	530	126 11¼	264	111 11¾	638	142 8¾
17–21	21.4	48.7	66.8	194.6	94 1	435.8	116 15¼	297	144 12¾	660	176 6½
22–26	27.2	45.74	58.6	182.5	86 5¾	372.2	125 5¼	310	146 3	628	178 4

As appears from the table, more conspicuously from the averages at the latter end of it, both the proportion of vegetation and the yields decreased in the main, as the drying of the cuttings increased. The yields of rows Nos. 6 to 10, however, of which the mean time of exposure was 8.6 days, and the mean loss 26.18 per cent, averaged slightly larger than those of Nos. 1 to 5. Nor did the proportion of vegetation appear to decrease until the cuttings had been exposed more than nine days and had lost twenty-five per cent of their weight. The yield calculated per hundred hills increased with the dryness of the cuttings, but this is quite as likely due to the increased room given the plants by the smaller vegetation of the dried cuttings as to greater vigor from the result of the drying. The cuttings were planted one foot apart in rows three feet apart.

As has already been mentioned, the early part of the season was exceptionally dry, less than two and a half inches of rain having fallen between May 1 and the first week in July.

The deductions from this experiment are, obviously, that exposing cuttings to the air of a moderately dry room for a week or ten days before planting is neither detrimental to their vegetation nor productiveness, while the tendency may be toward a slight increase in yield. A longer exposure than ten days, however, is injurious.

EXPERIMENTS IN ROOT GROWTH.

Under this head is reported:

1. A study of the development of young corn roots, with especial reference to the effects upon them of early cultivation.
2. An experiment intended to throw light upon the question whether cutting the roots of young corn plants is favorable or unfavorable to crop.
3. An experiment intended to show whether the location of roots in the soil is governed more by temperature or fertility.

THE GROWTH OF YOUNG CORN ROOTS.

On May 30, the roots of five corn plants, of which the seed had been planted eighteen days previously, were washed out and examined. The soil was a rich clay loam, and the average height, in the plants examined, of the tip of the tallest leaves raised erect, was ten and three fourths inches. The seed kernels, which were still intact, were two to two and a half inches below the surface.

The longest root, and especially the one that had made the largest development of fibers, in each of the plants examined, was the radicle or the root that starts at the base of the kernel. This did not in any case grow directly downward, but inclined at an angle of somewhat less than 45°, and its length varied in the different plants from seven to ten inches. It was in every case densely clothed with fibrous branches, some of which had already attained the length of eight or nine inches. On one root sixty of these branches were counted in the first inch below the kernel, and the number did not appear to decrease for a distance of eight inches. These branchlets averaged about three inches in length, from which it appears that the length of the fibrous roots, in a corn plant but eighteen days from planting, may easily aggregate more than 100 feet.

The roots that started out at the first node of the stem were rather numerous, and a few of them had attained the length of eight inches. These roots were, at this time, almost destitute of fibers, and probably did the plant little good. They grew nearly horizontal, and at no part of their length were more than three inches below the surface, while many were not deeper than two inches.

THE EFFECT OF EARLY CULTIVATION UPON CORN ROOTS.

The spade was inserted to the depth of three inches on four sides of several hills of corn, keeping about three inches from the stems, after which the earth was washed away from the roots of one hill. It appeared that twelve roots had been severed, some of which were radicles. Had the spade been inserted to the depth of four inches, it would probably have severed as many more.

The average corn cultivator, passing between rows of corn, the teeth reaching to the depth of three inches and within an equal distance of the plants, would probably not sever as many roots as did the spade in this trial, but it would necessarily displace, or at least disturb, all that lay within three inches of the surface.

On June 6 the roots of two other hills of corn, one of which had been root-pruned a week previous, were washed out and examined.

In the hill not root-pruned, the longer roots had attained a length of twelve to eighteen inches, and the longer nodal roots were becoming clothed with fibers near the base. The radicle had increased in length about in proportion to the other roots, and its fibers had also grown much.

An examination of one of the hills root-pruned a week previous brought out the following facts:

1. Although considerable rain (.13 inch) had fallen during the week, the pruning had apparently proved a serious check to the root development.
2. The root-pruning had stimulated the growth of fibers on the nodal roots.

3. The number of nodal roots was not perceptibly increased by the pruning.

In all the plants of the root-pruned hill, three in number, the radicle had been cut; in two of them two nodal roots had been cut, and in the other, three.

On June 13, one week later, a further examination was made. Very little rain had fallen since the last examination, and the surface soil was now becoming decidedly dry. A marked root growth, however, had taken place. The growth consisted of an increase in number and a decided increase in the length of the main roots, but especially in the development of fibers on the roots that start at the first node of the stem. The longer roots now reached horizontally a distance of two feet, so that those of adjoining hills intermingled somewhat, and many had grown downward to the depth of a foot or more.

The height of the plant, to the tip of the tallest leaf raised erect, in the plants examined, was thirty inches in the root-pruned hill, and about an inch less in the hill not root-pruned. The effect of the root-pruning was scarcely perceptible in the part of the plant above ground, but it was quite noticeable in the roots. The fibers were much more concentrated within the space circumscribed by the pruning tool, and the number of main roots that reached more than three or four inches from the plant was decidedly fewer in the root-pruned plant than in the other, while the longest roots were evidently those that had escaped the cutting. One root eight inches long had evidently grown out since the root pruning. In the plant not root-pruned the roots and fibers were more evenly distributed through the soil.

In the four root-pruned plants examined, the number of main roots was fifty-five, while it was sixty in the four not root-pruned, thus indicating that the root-pruning did not stimulate the production of main roots.

On June 28, a fourth examination was made. The effects of the root-pruning were still noticeable, the root growth near the plant being decidedly more concentrated in the root-pruned hill. The whole amount of root-growth appeared as great as, if not greater in the latter, than in the one not root-pruned. The fibers not only appeared more numerous, but they were larger and more sub-divided. A root from the pruned hill that was cut off in the pruning, and was five inches in length, had put out 180 fibers, while one of the same size and length in the other hill had put out but 111. This, however, only illustrates a part of the differences that actually existed, for the fibers in the root-pruned hill were much more developed than in the other.

The roots of potatoes appeared to be less affected by root-pruning than those of corn, and the difference seemed due to two facts, viz.: The cutting appeared to check the root growth less, and a larger proportion of the roots grew too deep to be reached by a pruning tool inserted at the depth of three inches.

It should be added that the above observations were made on plants growing on soil in a good state of cultivation, and abundantly supplied with plant food.

IS CUTTING THE ROOTS OF YOUNG CORN PLANTS FAVORABLE OR UNFAVORABLE TO CROP?

Passing a cultivator between the rows of growing corn, in the manner usually practiced by the farmer, accomplishes two quite different results, viz., it breaks up the capillary connection between the surface and deeper layers, and thus reduces evaporation from the soil, and it also destroys a larger or smaller proportion of the root development. The first of these effects is unquestionably beneficial. Is the second, in itself, beneficial or injurious?

In order to throw light upon this question, main plat G 10, containing one-twentieth of an acre, was planted with corn May 13. The soil had been well prepared, but was not in a good state of fertility, and no fertilizer was applied. The plan was to eliminate entirely the influence of stirring the surface soil, by withholding all cultivation, and to root-prune the plants of each alternate row to, as nearly as possible, the same extent as would be accomplished by the average corn cultivator, at the same time stirring the soil as little as possible. The weeds were removed from the whole plat by hand.

On June 6, when the young corn plants had attained the height of three to six inches, a lawn-edger was inserted to the depth of three inches on the four sides of each hill in every alternate row, keeping the tool three to four inches from the plants. Considerable rain (.76 inch) had fallen during the week previous, and the soil was abundantly moist. The plat was not again disturbed, except to pull a few weeds that appeared, until June 24, by which time the plants had attained about the size when they are usually cultivated the second time. A second root-pruning was now given, on the same rows, and in the same manner as the first. The soil was not very dry at this time, as 1.25 inches of rain had fallen within a week previous, .09 inch of which fell on the morning of the 24th. No further attention was given to the plat except to pull the weeds as they grew sufficiently large to require it.

The corn was not cut until all growth had ceased. On October 1, the stalks, with the ears intact, of each row were weighed, after which the ears were husked, assorted and weighed, with the following result:

CORN — THE INFLUENCE OF ROOT-PRUNING THE YOUNG PLANTS.

	ROOT-PRUNED.						NOT ROOT-PRUNED.				
	Weight of stalks with ears.	Number of merchantable ears.	Weight of merchantable ears.	Total number of ears.	Total weight.		Weight of stalks with ears.	Number of merchantable ears.	Weight of merchantable ears.	Total number of ears.	Total weight.
No. of Row.	lbs.		lbs.		lbs.	No. of Row.	lbs.		lbs.		lbs.
1	38½	42	13½	80	19½	2	55¾	64	26	90	29½
3	42	45	15½	86	22	4	50½	55	21	79	25½
5	41	32	13	78	20	6	55¾	56	22½	95	28
7	43	48	17¾	83	23¼	8	53¼	64	24½	90	29
9	36¼	37	12	81	17½						
Average	40⅛	$40\frac{4}{5}$	$14\frac{7}{20}$	$81\frac{3}{5}$	$20\frac{9}{20}$	Average	$53\frac{13}{16}$	59¾	23½	88½	28

From the table it is strikingly evident that the root-pruning in this case was injurious. If we calculate the product of merchantable corn per acre from the average yields, allowing eighty pounds of the freshly husked ears to represent a shelled bushel, it appears that the root-pruned portion yielded at the rate of thirty-two bushels and twenty-three pounds, and the portion not root-pruned at the rate of fifty-two bushels and seventy pounds; in other words, the root-pruning, as performed, made the difference between a poor and a good crop. The season, on the whole, from the time the corn was planted until the end of the first week in July, proved exceptionally dry. It should be remembered, however, that the pruning was performed at times when the soil was not in a dry condition.

Too much stress must not be placed upon the result of a single trial, but the outcome of this experiment is certainly suggestive.

IS THE LOCATION OF ROOTS IN THE SOIL GOVERNED MORE BY TEMPERATURE OR FERTILITY?

In 1886, several different garden plants were grown in three-inch drain tiles, set full length in the soil, in a vertical position, with the bottom open, and the space within filled with fertile soil.* It was observed that in every case where the plant made a good growth, the roots had penetrated through the tile to the bottom, after which they turned upward, growing in this direction until they reached the fertile layer of soil near the surface, when they changed their direction again, and extended horizontally. What induced the roots to grow in this manner? Evidently they did not grow upward in search of moisture. The soil was warmer and more fertile near the surface than near the bottom of the tile, and it was undoubtedly one of these inducements that attracted them upward. Had abundant nourishment been supplied at the base of the tile, and the roots were still found to have grown upward, the inference would be warrantable that they were attracted upward by warmth.

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* See Report New York Agricultural Experiment Station, 1886, p. 167.

In the spring of 1887, four pits were dug, each three feet in diameter and three feet deep. Two of these were filled to the top with fertile soil, mixed with compost; the other two were filled with the same to the depth of two feet, and finished to the top with the clay that had been taken from the bottom of the pits. In the center of two of these pits, one of which was filled to the top with fertile soil, and the other finished at the top with clay, two four-inch sole tiles were placed erect, one resting on the other, so that a tube was formed to the depth of twenty-eight inches. In each of the other two pits, one tile was placed, making a tube in the center fourteen inches deep. The tiles were then filled to the top with fertile soil, tamped in lightly to ensure a continuous column. Thus prepared, we had abundant fertile soil at the bottom of all the pits, while in two, the surface soil was a very infertile clay.

In each of the two pits containing the single length of tile, a few kernels of Waushakum corn were planted in the soil within the tile, while in the tiles of the other pits, seeds of the Student parsnip were planted. These plants were chosen because the corn is known to root shallow, and the parsnip deep. After the seeds had vegetated, the young plants were thinned to one for each pit. The corn plants made an excellent growth, and each produced several stalks. The one in the pit topped out with clay yielded three merchantable ears and five nubbins, and the other, three merchantable ears and two nubbins. The parsnip plants were a fair growth.

On September twenty-four, the roots of the corn plants were washed out and examined. In neither the pit filled to the surface with fertile soil, nor in the one topped out with clay did the roots incline upward to any extent. The appearance was the same as if the bottom of the tile corresponded to the surface of the soil. The roots were very much as in their natural position, extending in every direction except upward. A few fibers reached upward in both pits, but no more than in corn roots growing under ordinary conditions.

On September 29, the roots of the parsnip plants were examined in the same manner. Very few roots had penetrated to the bottom of the second tile, and these grew outward, inclining down. But in both plants, roots had grown out at the junction of the two tiles. In the pit filled to the surface with rich soil, these roots unquestionably inclined upward, some of the fibers reaching almost to the surface. In the other pit, where the junction of the tiles was about at the union of the fertile soil and clay, one large root came out and turned at once downward into the rich soil; another inclined downward, but descended gradually; a third grew straight outward, and some of its fibrous branches descended, while as many more ascended.

That the roots of the parsnip, a plant that thrives in cool climates, and roots very deeply, should have inclined upward more than those of corn, a shallow rooting, tropical plant, was hardly to be expected. The parsnip plants, however, did not make full development, while those of the corn made an unusually strong growth. Leaving out the parsnip case, which is perplexing, the fact that the corn roots made their full development more than a foot below the surface, while the greater part are usually found within the first four inches of soil, and while there was nothing to prevent them from rising to the warmer soil above, is evidence that abundant food and moisture are more essential to the development of corn than a high soil temperature.

In order to make sure that the roots of corn plants, growing under ordinary conditions, lay no deeper in the soil than usual the past season, the roots of plants were washed out and examined. They were found to be, as in former seasons, chiefly within two to five inches of the surface.

INSECTS AND INSECTICIDES.

1. Nitrate of potash and air-slacked lime for the cabbage maggot.
2. Applications for the larvæ of the potato beetle.
3. Applications for the codling moth.

NITRATE OF POTASH FOR THE CABBAGE MAGGOT.

By request of Dr. Lintner, State Entomologist, an experiment was made with a solution of nitrate of potash (saltpeter) for the cabbage maggot (larvæ of *Anthomyia brassicæ*, Bouche).

On the first indication that the cabbage plants were infested with this insect, which was on May 31, a solution of saltpeter, at the rate of one pound to two gallons of water, was applied to alternate rows of a plat of cabbage plants. The application, which was repeated on June 4, 10 and 16, was made by pouring one to two gills of the solution around the stem of each plant, from a sprinkling pot, from which the rose was removed.

On June 18, an examination was made of all the plants in four rows of the plat, fifty-five in number, with the following results:

Twenty-nine treated plants were attacked by 124 maggots.
Twenty-six not treated were attacked by 25 maggots.

One of the treated rows was on the outside of the plat, and it was observed that the plants in the outside rows, and at the ends of the inside rows were more infested than the others. The greater number of maggots found in the treated rows is to be ascribed to this fact, and not to an assumption that the nitrate of potash attracted the cabbage fly.

The last application was made but two days before the examination, but many live larvæ, that had apparently just hatched, were found in the treated rows, thus showing that the solution was harmless to the insects. As an additional test, a cabbage plant badly infested with maggots was placed in a flower-pot, and treated repeatedly with a saturated solution of the salt, but no effect upon the insects was observable.

AIR-SLACKED LIME FOR THE CABBAGE MAGGOT.

It has been claimed that lime placed about the roots of young cabbage plants will prevent injury from this insect. As an experiment, a quantity of air-slacked lime was mixed with the soil of two rows of a small plat of early cabbages at the time of setting the plants. As the season for the attack arrived it appeared that the plants of the plat were all suffering, and an examination made June 18, showed that twelve plants treated with the lime had sixty-six maggots, while eleven plants not treated had but twenty-four maggots, proving conclusively the ineffectiveness of the application.

APPLICATIONS FOR THE LARVÆ OF THE POTATO BEETLE.

1. *Paris green.*

In previous years we have sought to determine the minimum amount of Paris green, mixed with land plaster, that proves effective in destroying the larvæ of the potato beetle, *Doryphora 10-lineata*, Say. Several experiments indicated that one part of the poison to 150 of the plaster is sufficient when the two are thoroughly mixed.

Some potato growers, however, prefer to use water as a diluent for the poison. For the benefit of such, the attempt was made to discover the minimum amount of the latter that proves effective when used in this way.

One-fourth of an ounce of Paris green, mixed with five gallons of water, applied to the tops of a plat of potatoes on July 7, destroyed a portion, but not all, of the larvæ. Doubling the amount of the poison, however, the application proved almost entirely effective.

2. *London purple.*

This poison, used at the same rates as the Paris green, proved about equally effective. As it is considerably cheaper than the latter, the cost of the application is somewhat less, but as so little of the poison is used in either case, the difference in the expense is slight.

3. *Zoektein poison.*

An insecticide, bearing the above name, was received from the "Zoektein Company," of Albany, with the request to try it for various insects. It is a pale yellow powder, partially soluble in water, and was found, on test, to be an arsenite. On July 7, it was tested for the potato beetle larvæ, at the rate of one-fourth of an ounce to five gallons of water, and was found to be more effective than either Paris green or London purple, at the same rate of dilution. On doubling the proportion of the poison, the destruction of the insects was complete, while no apparent injury to the foliage followed. The exact composition of this insecticide, and the price at which it is sold, were not stated by the party sending it.

A trial of the same for the coddling moth is reported farther on.

4. *Rose's Tobacco Soap.*

This insecticide, though found effective for destroying insects in the green-house, had no effect on the larvæ of the potato beetle.

APPLICATIONS FOR THE CODLING MOTH.

1. *McDougall's Sheep Dip.*

A package bearing the above name was sent to the station by E. Jerome Woodford, West Candor, N. Y., with the request that it be tested for insects infesting fruit trees. It is a dark brown liquor, having a powerful odor resembling that of coal tar, and appeared very similar to, if not identical with, a preparation received from another source in 1884 under the name of Little's Soluble Phenyle. It is very readily soluble in water, forming a milky white solution. It is not claimed to be an active poison, and its value as an insecticide, if any, lies in its slight caustic properties and its powerful odor.

A thorough test was made with this preparation for the codling moth, in order to discover if this insect might not be repelled by its odor. If such proved to be the case, it would have the advantage over Paris green in being practically non-poisonous; hence no injury could follow either from the fruit, or the crop growing beneath the trees.

On May 25, seven Rhode Island Greening apple trees were sprayed with solutions of this preparation, in three different degrees of strength, and the applications were repeated at the same rates on May 30. The fruits from these trees, and also from two check trees in the immediate vicinity not sprayed, were examined on October 7, from which it appeared that in 2,254 apples from the sprayed trees the per cent injured by the codling moth was almost exactly the same as in 1,408 apples from the check trees; in other words, the applications were entirely unavailing for the purpose intended.

2. *The Zoektein Poison.*

On June 4, three trees of the Rhode Island Greening apple were sprayed with the above at the rate of one ounce to ten gallons of water. Very little rain fell thereafter until June, by which time it was so late that the application was not repeated.

On October 7, 1,244 apples from the treated trees were examined, of which 421, or about thirty-four per cent, had been injured by the codling moth. On the same day 746 apples were examined, from a check tree in the immediate vicinity, of which 358, or about forty-eight per cent had been injured by the same insect. As the latter percentage corresponds closely with that of the check trees in the preceding experiment, it is inferred that the application saved about fourteen per cent of the apples from injury. Had the trees been sprayed earlier, the benefit would probably have been greater, but as the insecticide did not reach the station until June 1, this was hardly possible.

It should be added that at the rate used, the foliage was slightly injured.

APPLICATIONS FOR THE PREVENTION OF APPLE SCAB.

1. *Hyposulphite of Soda.*

During the years 1885 and 1886* trials were made with hyposulphite of soda as a preventive of the disease known as scab in the apple, and due to a fungus named *Fusicladium dendriticum*, Fckl. In the latter year the experiment was extended to a pear tree known to be much infested with an allied species of *Fusicladium*. All of these applications appeared to prevent a part of the injury.

The past season the trials have been repeated on a more extended scale, so as to embrace the crab tree, treated in preceding years with seven trees of the Fall Pippin variety.

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*See Reports New York Agricultural Experiment Station, 1885, pp. 231–2; 1886, pp. 177–8.

One-half of all the trees was sprayed with the solution, leaving the other half untreated. Different trees of the same variety vary so much in the amount of the fungus that infests them, that the method adopted in the experiments for the codling moth, that of spraying one tree and leaving the next unsprayed, as a check, is hardly available.

The crab tree, which was of the Siberian variety, was sprayed five times, viz., on May seventh, sixteenth, twenty-fifth, thirtieth and June twenty-eighth. The first of these applications was at the rate of one pound of the hyposulphite to twenty gallons of water, the remainder at the rate of one pound to ten gallons. The tree was sprayed on the part not sprayed in previous years.

The Fall Pippin trees were also sprayed five times, viz., on May eleventh, twenty-first, twenty-fifth, thirtieth and August twenty-second, the solution in every case being at the rate of one pound to ten gallons.

On August twenty-fifth a quantity of fruit was picked from the sprayed and from the unsprayed part of the crab tree, and assorted into three qualities. In the first quality were put only fruits free from scab; in the second those slightly attacked, but not sufficiently to injure their market value, and in the third those much injured. The results were as follows:

	No. of fruits examined.	Per cent in first quality.	Per cent in second quality.	Per cent in third quality.
Sprayed part	662	87.9	11.2	.9
Unsprayed part	749	71.8	25.5	2.7

September fifth, a quantity of fruit was picked from the sprayed and unsprayed parts of the Fall Pippin trees and assorted into three qualities, as above noted, with the following result:

	No. of fruits examined.	Per cent in first quality.	Per cent in second quality.	Per cent in third quality.
Sprayed part	1,068	59.1	36.1	4.8
Unsprayed part	1,120	41.8	46.6	11.6

It appears that in both the crab tree and the Fall Pippin tree, the percentage of fruits in the first quality was greater in the sprayed portion, the difference amounting to about sixteen per cent in the former and about eighteen per cent in the latter. In the second and third qualities, on the other hand, the percentage is greater in the part of the trees not sprayed.

It seems probable that in orchards badly affected with the scab, the damage might be sufficiently lessened by the use of hyposulphite of soda to abundantly pay the slight cost of the applications. In cases where trees are to be sprayed for the codling moth, the salt could be dissolved in the same water that contains the poisoning material used, and thus the cost of a special application might be saved. Hyposulphite of soda is a white, crystalline salt, very readily soluble in water, and is not poisonous. It may be purchased at the ordinary village drug store at from six to ten cents per pound, and if ordered in larger quantities from a wholesale house, could be had correspondingly less.

2. *The "Audoynaud Process."*

Two of the formulæ that have been recommended by the Department of Agriculture for the treatment of the downy mildew and black rot of the grape, are also recommended as being possible preventives of the apple scab. One of these, viz., No. 2, of the third circular of the Section of Vegetable Pathology, was tested at the station. It consists of one pound of sulphate of copper, dissolved in three or four gallons of warm water, to which is added when cool, one pint of commercial ammonia, when the whole is diluted with water to twenty-two gallons.

It was found that at the strength noted, the liquid was too strong for the foliage of apple trees. Where one application was made, the leaves showed decided injurious effects, and where three were made the damage was correspondingly greater. The trees not being under normal conditions of growth, no estimate of the effect upon the fungus was made. Indeed, in the trees treated three times, the larger part of the fruits, in the sprayed part, fell off before maturity.

A STUDY OF THE MOVEMENTS OF SOIL WATER.

Under this head is reported:

1. The influence of atmospheric pressure upon percolation.
2. Experiments on capillary action in soils.
3. Progress in measuring the soil moisture.
4. A new lysimeter.
5. The height of water in wells.

THE INFLUENCE OF ATMOSPHERIC PRESSURE UPON PERCOLATION.

In an experiment made in the year 1885, planned for the purpose of studying the influence of stirring the surface soil upon drainage, it was observed incidentally that the flow of water was much greater on some days than on others; and on comparing the amount of flow with the barometric changes, a rather marked correspondence could be traced. It appeared that increased drainage accompanied a fall in the barometer, and *vice-versa.* This observation suggested the following series of experiments in December, 1886.

In the first trial, a five-inch "deep" flower pot was filled with clay soil, and after being submerged eighteen hours in a water tank to secure saturation, was placed upon a wire stand, within the receiver of an air-pump. When dripping from the soil had ceased, a part of the air was exhausted from the receiver, when the flow immediately recommenced, and when this had ceased, another part of the air was exhausted, when drainage again commenced. A third trial was accompanied with a like result.

The next trial was designed to show whether the dripping was due to a certain degree of exhaustion of the air, or was only the result of a change in atmospheric pressure. The air was admitted to the receiver, and a column of mercury connected with the latter so that the degree of exhaustion could be measured. The air was then rarefied until the water began to drip freely from the pot of soil. When this drainage had ceased, the air was let into the receiver once more, and after an interval, exhausted to the same degree as before. The dripping again commenced, and the test was repeated with the same result, indicating that the percolation was due to a change from a heavier to a lighter air pressure, rather than to the reduction of the air pressure to a given limit.

On considering the cause for these phenomena, the one first suggested was that the air contained in the interstices of the soil, and in the water with which the soil was saturated, would naturally tend to expand on the removal of a part of the atmospheric weight, and would thus exert a corresponding pressure upon the water held in the soil by capillary attraction. This would in effect decrease the force of capillarity, and a portion of the water would be set free.

As a test for the above hypothesis a third trial was made. A bottle of about 400 c. c. capacity was taken, and through its cork, which was of rubber, a slender glass tube was inserted to such a distance as to nearly reach the bottom of the bottle. The cork was then removed, and the bottle filled with spring water, after which it was replaced, and the air bubbles beneath it were let out by inserting a pin between the cork and the neck of the bottle, so that the vessel was completely filled with the water. The bottle was then placed under the receiver, and the air pressure reduced to seven pounds per square inch. The water immediately rose in the tube to the height of rather more than five-eighths of an inch, indicating an expansion of the air contained within the water. On admitting the air again, the liquid receded to its former height.

These results seem to prove that changes in atmospheric pressure affect percolation. During the past season an investigation has been made of the flow of water from farm drains, with especial reference to this question. A general, though not an exact coincidence, was readily observed between the fluctuations of the barometer and of the drainage.*

EXPERIMENTS ON CAPILLARY ACTION IN SOILS.

1. The height to which water rises by capillarity in different soils, and its rate of progress.
2. The influence of matters in solution upon the height to which water rises by capillarity.
3. The rate of capillary flow through different soils.
4. The influence of matters in solution upon the rate of capillary flow.

The Height to Which Water Rises by Capillarity in Different Soils, and its Rate of Progress.

Four glass tubes, each five feet long and very nearly one and five-eighths inches inside diameter, were supported in a vertical position by means of a stand constructed for the purpose. The lower end of the tubes entered a copper pan, in which distilled water was kept at a very nearly constant depth by means of an inverted supply bottle. The samples of soil were retained in the tubes by covering the lower end of the latter with fine brass wire-cloth, over which was placed a circular piece of filter-paper of a diameter corresponding to that of the tube, the wire cloth being kept in position by bending it upwards about the tube, and winding it tightly with fine copper wire. Thus the filter-paper prevented the passage of the soil through the wire cloth, while it permitted free access of water.

Tube No. 1 was filled with muck, No. 2 with garden soil, No. 3 with sand and No. 4 with clay, all the soils being air-dry and sifted through a sieve containing 100 meshes to the inch. The progress of the water upward by capillary attraction, as indicated by the change in color, was noted daily from May 5 to November 17*. The accompanying table shows the height of the water at the end of each week, and also the weekly progress for the different soils:

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* An illustrated article contributed by the writer to Agricultural Science, Vol. I, pp. 173–177, gives a full report of this investigation.

THE RISE OF WATER BY CAPILLARY ATTRACTION IN DIFFERENT SOILS.

		TUBE NO. 1, MUCK.		NO. 2, GARDEN SOIL.		NO. 3, SAND.		NO. 4, CLAY.	
		Height of water.	Progress during week.	Height of water.	Progress during week.	Height of water.	Progress during week.	Height of water.	Progress during week.
		inches.	inches.	inches.	inches.	inches.	inches.	inches.	inches.
May	5, 6 P. M	1½	......	2⅜	......	3¼	......	2⅛	......
	12, 7 A. M.	10¾	9¼	17¾	15⅜	7¾	4½	17½	15⅜
	19, 7 A. M.	12¾	2	23¼	5½	9	1¼	21	3½
	26, 7 A. M.	14¼	1½	26½	3¼	10	1	23¾	2¾
June	2, 7 A. M.	15	¾	28⅝	2⅛	10½	½	25⅛	1⅜
	9, 7 A. M.	15½	½	29⅞	1¼	†11¾	¼	26	⅞
	16, 7 A. M.	16	½	32	2⅛	13	¼	27¼	1¼
	23, 7 A. M.	16¾	¾	33¾	1¾	14⅛	1⅛	28	¾
	30, 7 A. M.	17	¼	85⅛	1⅜	15	⅞	29¼	1¼
July	7, 8 A. M.	17¾	¾	36⅝	1½	16¼	1¼	30	¾
	14, 7 A. M.	18⅛	⅜	37⅝	1	16⅞	⅝	30⅜	⅜
	21, 7 A. M.	18¾	⅝	38¾	1⅛	17⅛	¼	31½	1⅛
	28, 7 A. M.	19⅛	⅜	39¾	1	17½	⅜	32¼	¾
Aug.	4, 7 A. M.	19¼	⅛	40¾	1	18	½	33	¾
	11, 8 A. M.	19¾	½	41½	¾	18⅜	⅜	33½	½
	18, 7 A. M.	20	¼	42¼	¾	18½	½	34	½
	25, 7 A. M.	‡20⅞	......	42⅞	⅝	18¾	¼	§......	......
Sept.	1, 7 A. M.	21⅛	¼	43⅝	¾	18⅞	⅛	......	......
	8, 7 A. M.	21⅜	¼	44⅛	½	19⅛	¼	......	......
	15, 7 A. M.	21⅝	¼	44⅝	½	19¼	⅛	......	......
	22, 7 A. M.	21⅞	¼	45¼	⅝	......	......	......	......
	29, 7 A. M.	22	⅛	45½	¼	19⅝	⅜	......	......
Oct.	6, 7 A. M.	22¼	¼	46	½	19¾	⅛	......	......
	13, 7 A. M.	22⅜	⅛	46⅜	⅜	19¾	0	......	......
	20, 7 A. M.	22⅝	¼	46¾	⅜	19⅞	⅛	......	......
	27, 7 A. M.	22¾	⅛	47¼	½	20	......	......	......
Nov.	3, 7 A. M.	22⅞	⅛	47⅝	⅜	20⅛	......	......	......
	10, 7 A. M.	23	⅛	47⅞	¼	20⅛	......	......	......
	17, 7 A. M,	23¼	¼	44	⅛	20¼	......	......	......

THE INFLUENCE OF MATTERS IN SOLUTION UPON THE HEIGHT TO WHICH WATER RISES BY CAPILLARITY.

It is stated in works on physics that water rises higher than any other liquid in capillary tubes. To what extent do the slight proportions of soluble matters usually present in soil water influence the height to which it is capable of rising by capillarity? As a partial answer to this question, two capillary tubes of which the diameters were 80 and 90 micro-millimetres respectively, and the length fourteen inches, were attached to a standard rule graduated to fortieths of an inch. This rule was then clamped to a support in a vertical position, and the lower end of the tubes introduced into the liquids named in the table below. The figures expressing the height to which the various liquids rose in the tubes represent fortieths of an inch, and are the average for all the trials, and for the two tubes:

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* This is the latest date to which the experiment could be conveniently reported. The water at this date had not ceased to rise, except in tube No. 4.

† A slight break in the column occurred at this time, caused by settling of the sand below the wet line. This may have interfered with the subsequent progress of the water.

‡ During the week, the point of measurement was changed to another part of the tube where the water had advanced higher.

§ From this time the progress of the water could no longer be accurately determined, as the color shaded so gradually from the moist part to the dry. It appeared to advance scarcely at all after this date.

THE INFLUENCE OF MATTERS IN SOLUTION UPON THE HEIGHT TO WHICH WATER RISES IN CAPILLARY TUBES.

	Temperature F.	Specific gravity at 49° F.	Number of trials.	Capillary height.	Date.
Manure water	68°	1,010	12	187.79	Feb. 22
One-half manure water	68	....	16	189.62	Feb. 22
One-fourth manure water	68	....	8	190.94	Feb. 22
Distilled water	68	....	8	190.87	Feb. 22
One-fifth manure water	68	....	12	189.44	Mar. 7
One-tenth manure water	68	....	12	189.87	Mar. 7
Distilled water	68	....	12	190.60	Mar. 7
Water filtered through muck	68	1,007	36	189.	Feb. 26
Water filtered through garden soil	65	1,007	24	191.04	Feb. 24
Distilled water	65	....	24	191.67	Feb. 24

It is evident from the figures that the tendency of all the solutions is to lower the height, but the influence is so small as to be practically of little importance. Other tests were made with water filtered through wood ashes, and with solutions of sulphate and muriate of potash, nitrate of soda, phosphate of lime and sulphate of ammonia. In all the tendency was to reduce the height, and in proportion to the strength of the solution.

THE RATE OF CAPILLARY FLOW THROUGH DIFFERENT SOILS.

The rate at which water passes through a soil by capillarity is of more importance to the agriculturist than the ultimate height to which it may rise in the same soil, because a soil capable of supporting a crop must necessarily be within reach of capillary water. A series of experiments was undertaken to discover the comparative rate at which water passes through samples of garden soil, sand, clay and muck.

Glass combustion tubes of about nine-sixteenths inch inside diameter, and five to six feet in length, were bent slightly at one end and attached to a board in such a way that when the board was placed in a horizontal position the bent end of the tubes could enter a dish of water. One such tube was filled with each of the soils above named, all of the samples having been sifted through a sieve containing 100 meshes to the inch, and after the filling, the soils were carefully jarred down by holding the board in a vertical position, lifting it slightly and letting it drop upon the floor, continuing this process until the soils ceased to settle. After this, the tubes were again filled by the addition of more soil. The board was then placed in a level position, and the bent end of the tubes connected with a pan of water, the latter being kept filled to the brim. By this arrangement, the influence of gravity upon the action of capillarity is practically eliminated, as the water is required to rise scarcely more than the diameter of the tube, after which it passes the remaining distance in a horizontal direction, and is resisted only by the friction of the particles.

THE RATE OF CAPILLARY FLOW IN DIFFERENT SOILS.

	Dec. 13.	Dec. 20.	Dec. 27.	Jan. 3.	Jan. 10.	Jan. 17.	Jan. 24.	Jan. 31.
Clay	16⅞ in.	23¾ in.	28⅛ in.	31¾ in.	34½ in.	36¾ in.	38⅞ in.	40¾ in.
Garden soil..	12⅛	19⅞	26⅛	31⅛	35⅞	40⅛	44⅛	47¾
Muck	41½	50¼	59⅝*	....	....	....	....	....
Sand†.	....	....	....	....	....	....	....	....

It has been ascertained that the rate of capillary flow is inversely in proportion to the diameter of the tube or pores. From this we may infer that the pores were largest in the sand, next in the muck, and smallest of all in the garden soil. The fact that the rate in the clay was not so well maintained as in the garden soil may be due to the fact that the clay became more consolidated on getting wet.

THE INFLUENCE OF MATTERS IN SOLUTION UPON THE RATE OF CAPILLARY FLOW.

Four glass tubes were filled with garden soil, sifted through a sieve of 100 meshes to the inch, and were placed in a horizontal position as described in the last experiment, two being connected with distilled water, and the remaining two with a saturated solution of nitrate of soda. It was commenced on February 17, and continued until February 28, with the following results:

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* Finished. † Finished in two days, 60 in.

INFLUENCE OF NITRATE OF SODA UPON THE RATE OF CAPILLARY FLOW.

	DISTANCE TRAVERSED ON—											
	Feb. 17, 6 P. M.	Feb. 18, 6 P. M.	Feb. 19, 6 P. M.	Feb. 20, 5 P. M.	Feb. 21, 6 P. M.	Feb. 22, 6 P. M.	Feb. 23, 6 P. M.	Feb. 24, 6 P. M.	Feb. 25, 6 P. M.	Feb. 26, 6 P. M.	Feb. 27, 8 A. M.	Feb. 28, 6 P. M.
	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.
Tube No. 1, distilled water..	4⅝	10⅝	14	16½	19⅛	21⅜	23⅜	25⅛	26⅝	28¼	29⅛	30¼
Tube No. 2, distilled water..	4⅛	10⅜	13½	16	18¼	20½	22¼	23⅞	25¼	26⅝	27½	28⅝
Tube No. 3, nitrate of soda .	2¾	6¾	9	10½	12¼	13¾	15	16	17	17¾	18¾	19¼
Tube No. 4, nitrate of soda .	3⅛	7	9⅜	10¾	12½	14	15¼	16¼	17¼	18⅛	18⅝	19½
Temperature of room	66	54	47½	50	60	56	56½	48½	58¾	48	45½	49¾

From this, it is very evident that nitrate of soda in a saturated solution decidedly retards the rate of capillary flow.

In the next trial eight tubes were arranged and filled precisely as in the last, with the exception that the garden soil used was washed, by filtering distilled water through it until it was free from matters readily soluble. Two of these were connected with distilled water two with water that had been filtered through muck, two with water filtered through garden soil, and the remaining two with manure water. The experiment was commenced March 10 and continued until April 27. The rate of progress was marked daily, but only weekly periods are reported in the table:

THE INFLUENCE OF MATTERS IN SOLUTION UPON THE RATE OF CAPILLARY FLOW.

	PROGRESS OF THE LIQUID.									
	Specific gravity at 49° F.	March 10, 6 P. M., inches.	March 17, 6 P. M., inches.	March 24, 6 P. M., inches.	March 31, 6 P. M., inches.	April 7, 6 P. M., inches.	April 14, 6 P. M., inches.	April 21, 6 P. M., inches.	April 27, 7 A. M., inches.	
Tube No. 1. Distilled water...	.....	$1\frac{7}{8}$	$28\frac{3}{4}$	$42\frac{1}{2}$	$52\frac{3}{8}$	$61\frac{1}{4}$	$69\frac{3}{8}$	...	..	Finished April 15, 7 A. M., $69\frac{1}{2}$ in.
2. Distilled water...	.....	$2\frac{1}{8}$	28	$40\frac{3}{4}$	$49\frac{7}{8}$	$58\frac{3}{8}$	$66\frac{1}{8}$	...	..	19, 6 P. M., $70\frac{1}{2}$ in.
Tube No. 3. Muck water......	1,007	$3\frac{5}{8}$	$35\frac{1}{2}$	$49\frac{1}{2}$	$58\frac{5}{8}$	$66\frac{3}{4}$	...	...	..	Finished April 14, 7 A. M., $73\frac{7}{8}$ in.
4. Muck water......	1,007	$3\frac{1}{2}$	$34\frac{3}{4}$	$49\frac{1}{2}$	$59\frac{1}{4}$	$68\frac{5}{8}$	...	...	..	11, 6 P. M., $73\frac{3}{4}$ in.
Tube No. 5. Garden soil water.	1,007	$2\frac{5}{8}$	$33\frac{3}{4}$	48	$58\frac{1}{4}$	$67\frac{3}{4}$	...	...	..	Finished April 14, 7 A. M., $75\frac{1}{2}$ in.
6. Garden soil water.	1,007	$2\frac{1}{2}$	35	$49\frac{7}{8}$	$59\frac{1}{2}$	$67\frac{7}{8}$	...	...	..	14, 7 A. M., $75\frac{1}{4}$ in.
Tube No. 7. Manure water....	1,010	$1\frac{3}{4}$	$18\frac{3}{8}$	$20\frac{3}{4}$	$21\frac{1}{4}$	...	...	...	..	
8. Manure water...	1,010	$1\frac{3}{4}$	20	$24\frac{7}{8}$	$27\frac{1}{8}$	$29\frac{7}{8}$	31	$31\frac{3}{4}$	$32\frac{1}{4}$	

The indications are very clearly that the soluble matters contained in the water from the muck, and the garden soil promoted the capillary flow, but that some quality of the manure water retarded it. The latter was passed through filter paper before being used, but may still have contained viscous material that tended to clog the pores of the soil. In another experiment with vertical tubes, one of which was connected with manure water and the other with distilled water, the manure water again fell behind.

The next trial was intended to discover whether or not the rate of capillary flow may be promoted by the addition of any special substance to the water. The first test was with sodium chloride (common salt). A comparatively pure article of dairy salt was used, and solutions of twenty, ten, five and two and a half per cent respectively were connected with the horizontal tubes, as described in the last experiment.

THE INFLUENCE OF SODIUM CHLORIDE UPON THE RATE OF CAPILLARY FLOW.

TUBE.	PROGRESS OF THE LIQUIDS.						
	June 1, 6 P. M.	June 8, 7 A. M.	June 15, 7 A. M.	June 22, 7 A. M.	June 29, 7 A. M.	July 6, 7 A. M.	
	in.	in.	in.	in.	in.	in.	
No. 1, distilled water......	2⅜	30	43½	....	....	....	Finished June 19, 47¼ in.
2, distilled water......	2¾	29⅞	44⅝	56½	65⅞	....	Finished July 4, 72⅝ in.
No. 3, 5 per cent solution.	3⅝	37¾	54⅝	67	....	....	Finished June 27, 73¾ in.
4, 5 per cent solution.	3¼	38⅛	53½	64¾	72⅞	....	Finished July 1, 74¼ in.
No. 5, 10 per cent solution.	2⅜	34½	51⅝	64½	73½	....	Finished June 29.
6, 10 per cent solution.	2⅝	33⅝	50⅝	62⅞	72¼	....	Finished June 30, 72⅞ in.
No. 7, 20 per cent solution.	1¼	28⅝	43¼	54¾	63½	72⅝	Finished July 7, 73¾.
8, 20 per cent solution.	3⅜	29½	43⅞	54⅝	62¾	71⅛	Finished July 9, 74 in.

SECOND TEST — IN PART A DUPLICATE OF THE PRECEDING.

TUBE.	PROGRESS OF THE LIQUIDS.				
	Aug. 25, 7 A. M.	Sept. 1, 7 A. M.	Sept. 8, 7 A. M.	Sept. 15, 7 A. M.	
	in.	in.	in.	in.	
No. 1, distilled water	9⅛	37⅜	50⅝	....	Finished Sept. 10, 52⅛ in.
2, distilled water	8⅛	37¾	52⅞	63¼	Finished Sept. 21, 6 P. M., 71⅞ in.
No. 3, 2½ per cent solution	11⅝	48	64⅛	....	Finished Sept. 14, 73½ in.
4, 2½ per cent solution	10¾	46	62⅜	73⅜	Finished Sept. 15.
No. 5, 5 per cent solution.......	9¾	45¼	62½	....	Finished Sept. 14, 72¼ in.
6, 5 per cent solution.......	9	43½	60¾	72	Finished.
No. 7, 10 per cent solution.......	8⅜	41⅜	59⅜	70¼	Finished Sept. 17, 72⅞ in.
8, 10 per cent solution.......	9	41⅝	58	68¼	Finished Sept. 19, 73 in.

It is very evident that the addition of the salt in quantities of ten per cent, or less, promoted the capillary flow, and that with the solutions tested, the maximum rate was reached in the weakest one. The twenty per cent solution, on the other hand, retarded the rate. In another trial made later, solutions at the rate of two and one-half per cent, one and one-quarter per cent, and five-eighths of one per cent respectively, were used. The result indicated little difference in the rate of flow with these solutions.

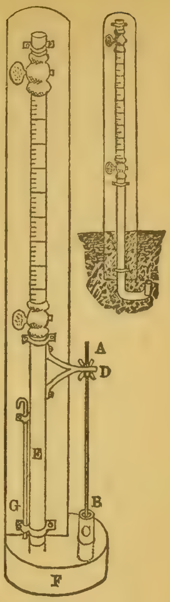
The trials do not show whether the influence of the sodium chloride and the other soluble matters experimented with upon the rate of capillary flow is due to the presence of a particular substance, or whether it is due to a change in the liquid that would be affected as well by dissolving a small amount of any mineral matter in it. Neither do they show that the influence of matters in solution affects the rate of capillary flow in a vertical direction in the same way as in a horizontal direction. Further experiments are needed to develop this interesting subject.

PROGRESS IN MEASURING THE SOIL MOISTURE.

1. Improvements in the soil hygrometer.
2. Experiments to determine whether or not the rate of absorption in the soil is in proportion to its dryness.

In the Report of the Station for 1886, p. 182, is illustrated an instrument designed for measuring the rate of absorption in the soil from a piece of saturated terra-cotta, this rate being assumed to be in proportion to the dryness of the soil. During the past season, considerable attention has been given to perfecting this instrument, which, in its improved form, is shown in the accompanying drawing, the apparatus described last year being shown in a smaller drawing at the right.

In its most primitive form, the instrument may be described as a tube closed at the top, and curved into a return bend at the bottom, with a short cylinder of terra-cotta or other absorbing material inserted part of its length into the short arm, and extending into the bend of the tube. If such a tube is filled with water and its lower end buried in a soil not in a saturated condition, the moisture from the terra-cotta will be absorbed by the soil, and as the water is removed from the curved part of the tube, air bubbles will rise into the long arm, thus supplying more water, while the amount thus removed may be registered at the top. Instead of having the tube closed at the top, one open at the top and provided with two stop cocks, so that it may be refilled with water without removing it from the soil, is used.



In order that such an instrument may be corrected to a standard, the amount of surface exposed by the terra-cotta must be delicately adjustable. This is accomplished by means of the slender brass rod A B, which has threads cut upon its upper end, upon which work the thumb screws shown at D. The rod passes through the cylinder of terra-cotta C, which is attached to it by a small brass washer soldered to the rod at each end of the cylinder. By turning the thumb screws at D, the cylinder is raised or lowered at will, and may be fastened securely at any desired point.

As illustrated in the last report, the tube E made a return bend at the bottom and the cylinder of terra-cotta was inserted directly into the open end. This introduced an error, as the expansion and contraction of the air in the upper end of the tube due to changes in temperature or atmospheric pressure, caused a considerable fluctuation in the height of the water in the short arm, and consequently the cylinder of terra-cotta was unequally supplied with water at different times. In order to avoid this error as far as possible, the shallow closed cup F has been substituted for the bend in the tube. The diameter of the cup is three inches, while that of the tube is but half an inch; hence the slight variations in altitude of the water in the tube due to meteorological changes exert scarcely a perceptible influence upon the depth of water in the cup. A third change consists in the addition of the slender tube G, which forms a connection between the air above the water in the cup, and the external air, thus insuring access of the latter at all times to the cup. This access might become wholly or in part obstructed by the soil, if the only communication between the cup and the external air were by the orifice through which the terra-cotta passes into the cup.

This instrument is designed to be placed in the soil in autumn, in order that the earth may become compact about it in a natural manner; or it may perhaps be inserted at any other time by making the hole just large enough to receive it, and then partially filling this hole with puddled earth in order to secure complete contact of the soil with the terra-cotta.

It is proposed to adjust the instrument to a standard in the air, as it would be difficult or impossible to do this in the soil.

EXPERIMENTS TO DETERMINE WHETHER OR NOT THE RATE OF ABSORPTION IN THE SOIL IS IN PROPORTION TO ITS DRYNESS.

That our hypothesis, that the rate at which soil absorbs water is in proportion to its dryness, is correct, is rendered probable though not proved, by the following tests:

In the first trial, a piece of air dry terra-cotta was immersed repeatedly for a period of fifteen seconds in spring water, at a temperature of 44°, until it ceased to gain weight, and after each immersion placed under a bell glass for two hours or longer to allow the water absorbed to equalize through the mass. It was weighed immediately before and after each immersion, and the gain in weight noted.

A second trial was made with two absolutely dry bricks, in the same manner, except that the bricks were immersed thirty instead of fifteen seconds. These materials were chosen because, while being of a similar nature to soil, they do not slack in water. The amounts of water in grams absorbed at each immersion were as follows:

	AMOUNT OF WATER ABSORBED IN THE—									
	First immersion.	Second immersion.	Third immersion.	Fourth immersion.	Fifth immersion.	Sixth immersion.	Seventh immersion,	Eighth immersion.	Ninth immersion.	Tenth immersion.
Terra cotta	33.25	24.9	20.1	19.5	16.8	10.5	8.6	5.7	3.2	0
Brick No. 1	190. 5	58.1	13.5	32.2	7.8	11.8	0	....	....	.....
Brick No. 2	107. 2	72.5	51.7	27.5	.8	3.6	0	....	....	.....

It appears that the amount absorbed in brick No. 1 did not decrease regularly with each immersion. This brick appeared to absorb moisture from the other one while the two were in contact, under the bell glass. At least No. 2 lost moisture under the bell glass, while No. 1 sometimes gained. This may account for the irregularity.

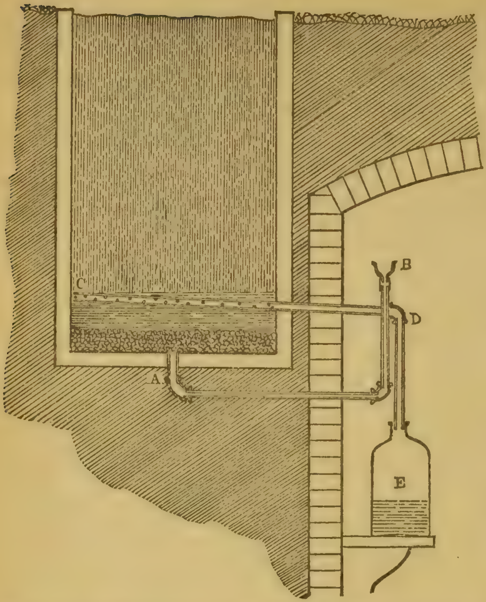
In the third trial, the instrument used for measuring absorption from the soil, already described, was placed in a cylindrical glass jar, about seven inches inside diameter, and twelve inches in depth, the jar being filled to the top with air-dried garden soil that had been pulverized, and passed through a sieve containing 100 meshes to the inch. The instrument was set in the soil at such a depth that the top of the terra-cotta cylinder was about two inches below the surface. A circular piece of oil-cloth was fitted about the instrument, and tied over the top of the jar, in order to exclude evaporation, and the jar was placed in a close tank-room beneath the barn, where the atmosphere is very moist. The trial commenced July 25, and at date (November 14), is still in progress. The absorption was recorded each morning, but only the amounts absorbed during weekly periods are here reported:

1st	week	81.8	cubic	centimeters.	9th	week	32.2	cubic	centimeters.
2d	“	58.6	“	“	10th	“	36.3	“	“
3d	“	62.2	“	“	11th	“	27.9	“	“
4th	“	69.6	“	“	12th	“	24.5	“	“
5th	“	55.7	“	“	13th	“	21.5	“	“
6th	“	57.4	“	“	14th	“	20.5	“	“
7th	“	57.9	“	“	15th	“	11.5	“	“
8th	“	39.6	“	“	16th	“	22.9	“	“

It appears that the absorption decreased as the soil became moist, though the rate of decrease was by no means regular. The instrument might perhaps better have been placed so that the terra-cotta cylinder was at the center of the column of soil, instead of near its top. As it was, gravity probably assisted the absorption by attracting the water downward. After the soil had all become partially wet to the bottom of the jar, which occurred about the eighth week of the trial, the rate of absorption immediately fell off, and thereafter decreased more regularly.

A NEW LYSIMETER.

The lysimeters in use at the station do not differ in kind from those employed at Rothamsted and elsewhere. But a study of their operation has developed the fact that the data secured from them are not applicable to the soil in its natural condition. The soil within being in connection with no permanent water-table, and the acquisition of water by capillarity from beneath being entirely excluded, the conditions within the inclosed prisms of earth are radically different from those existing in the outside soil. The earth within becomes abnormally dry in times of drought, and on the advent of rain absorbs more water than it would if not thus isolated. The upward movement of the soil water in fair weather being restricted, the soluble soil constituents wash downward faster and appear in the drainage water in greater proportion than is the case under normal conditions.



In the true lysimeter the movements of water must be the same as in the natural soil. As a means of approaching this condition, an apparatus for which I am in part indebted to the suggestions of the station chemist, Dr. Babcock, has been constructed after the plan shown in the accompanying drawing. It differs from the lysimeter heretofore used in being provided with an artificial water-table, which is kept at a nearly constant height by the addition of sufficient water daily to make up the loss from evaporation. The tube that passes out through the bottom of the lysimeter at A, instead of serving as the outlet for drainage, curves upward, forming a supply-pipe, water being added at the funnel B. The drainage passes out through the drainpipe C D, which is perforated in the part within the lysimeter, and of which the lower end enters the bottle E.

In order to insure an even distribution of the water, a layer of pebbles is placed at the bottom of the lysimeter, and this is covered with another of clean sand, the latter reaching up far enough to cover the drain-pipe. Thus the soil above, while not directly in contact with water, rests upon a constantly saturated layer of sand.

This lysimeter furnishes not only a measure of percolation, but also during dry weather, an approximately correct daily record of soil evaporation. The excess of drainage over the quantity of water added through the supply-pipe represents the percolation, while the difference between the amount added and the drainage equals the evaporation. The total evaporation for a given period is the difference between the total amount added plus the total rainfall, and the total drainage.

The conditions within this lysimeter differ from those in the outside soil in the height of the water-table being constant. But by providing lysimeters of various depths and by noting the fluctuations in the height of the natural water-table, a fair estimate may be formed of the movements of water in the natural soil.

THE HEIGHT OF WATER IN WELLS.

As having a possible bearing upon some of the phenomena connected with the movements of soil water, a series of measurements has been made during the past year, of the height of the water in an abandoned well near the station buildings. This well, which is forty feet in depth, is situated near the top of a ridge of such a height that in three directions it is necessary to go but a few hundred feet before reaching land that lies lower than the bottom of the well, while in the other direction is a railroad cut, the bottom of which is but slightly above that of the well. It would appear therefore that the water in this well must be sustained almost entirely by the capillary attraction exerted by the soil.

The measurements commenced December 3, 1886, and have been continued daily until the present time (November 15, 1887). In the table below is given the distance from the curb to the surface of the water on the 3d of December, and on the first day of each month thereafter, and also the rainfall of the preceding month in inches:

DATE.	Distance to water.		Rainfall of preceding month.
	feet.	inches.	
December 1	13	2	3.48
January 1	6	4	1.24
February 1	5	8	.18
March 1	4	10¼	2.97
April 1	5	0¾	.48
May 1	4	2¼	1.37
June 1	6	10	.46
July 1	9	2	2.01
August 1	10	5¾	6.37
September 1	11	3	3.03
October 1	13	4½	.75
November 1	15	4½	1.74

The figures have some interest as showing to what extent the soil water was depleted through evaporation during the summer and autumn months, notwithstanding the rainfall. The water in the well rose rapidly during December, and continued to rise more or less until May 3d, at which time it was 9 feet 1 inch higher than on December 3d, having risen on the average about three-fourths of an inch per day. From this time it commenced to fall, and has continued to recede almost without intermission until the present time (November 15), when the surface is 16 feet 1 inch below the curb or 12 feet lower than on May 3. The rainfall from November 15 to May 1, was 8.83 inches, or about 1.6 inches per month. From May 1 to November 15, it was 20.81 inches, or about 3.2 inches per month. In other words, a rainfall of 1.6 inches per month during the colder part of the year increased the amount of soil water sufficient to raise the well water three-fourths of an inch per day during the whole period, while despite a rainfall of double that amount during the remainder of the year, the soil water was so much depleted by evaporation that the well water lowered at an equal rate per day. The indications are that the soil becomes stocked, so to speak, with water during the colder part of the year, and that it pays out during the summer and autumn at a far more rapid rate than it is replenished by the rains of these seasons.

VEGETABLES.

A description of varieties, with classification, lists of synonyms and bibliography of

1. The Garden Beet.
2. The Carrot.
3. The Radish.
4. The Turnip.
5. The Onion.
6. The Celeriac.
7. Celery.
8. Spinach.
9. The Cucumber.
10. The Squash and Pumpkin.
11. The Egg Plant.
12. The Tomato.

INTRODUCTORY.

In this report is presented descriptions, with a classification, lists of synonyms and bibliography of the more important vegetables not heretofore reported upon,* with the exception of the melons and cauliflower, of which the plants have generally failed to make normal development in the Station garden; and of the pepper, of which our notes are still incomplete.

The data from which the descriptions are made have been accumulating since 1882, and nearly all of the varieties described have been grown more than one season.

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* Similar data were presented with reference to the garden bean, in the reports of the Station for 1882 and 1883; to the Sweet Corn in 1884; to the Pea in 1884; the Lettuce in 1885, and the Heading Cabbage in 1886.

NAMES AND AUTHORITIES.

As in former reports, liberty has not* been taken to change names, however inconvenient they appeared, but in every case where there was a choice, the name that seemed most appropriate has been adopted.

Although the list of varieties described in the vegetables treated is rather exhaustive, it is not supposed to be complete. Some, of which our notes do not furnish full data, have been omitted, and a few named in the seed catalogues have not been grown at the Station.

The list of synonyms, though often rather extensive, has been confined to those actually tested in the garden, and to those taken from horticultural works. Had the slightly differing names that seed catalogues apply to standard varieties been added, the number of synonyms might in many cases have been greatly increased.

How far these descriptions will prove reliable under other conditions of soil and climate, is a question that experiment must decide. They are offered only as a contribution to vegetable botany.

The authority is appended for both the names and synonyms. An authority printed in small capitals indicates that the variety to which it is appended has already been more or less thoroughly described, under that name, by the author, or in the work cited.† This furnishes a rather complete bibliography of the varieties.

An authority added to the adopted name of a variety, and printed in small letters, without a date, indicates that this name has been given as a synonym by the author or in the work cited.

The date or dates appended indicate that the authority is a seedsman, from whom the seed was procured under the name, and in the year or years specified.

Synonyms that have been determined or verified at the station are printed in italics. In cases of doubt the name is followed with the interrogation point. Synonyms not printed in italics have not been verified, and are given only on the authority appended to them.

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* A single exception occurs in the case of the Yellow Pattypan squash, to which the word "pattypan" was annexed in order to ally it with its near relative, the White Pattypan.

† Initials are sometimes used as abbreviations for the names of seed firms, as H. & W., J. & S., etc. Though of necessity printed in capitals, these do not in any case refer to authors.

EXPLANATION OF ABBREVIATIONS, WORDS, AND PHRASES USED IN THE DESCRIPTIONS.

For a list of the abbreviations of the names of seedsmen see the close of the report of the Horticulturist in this volume.

Abbreviations for the names of authors and works upon gardening are used as follows:

A. de Cl.—*Album de Clichés*, Vilmorin, Andrieux et Cie., 1883.

BRILL.—Farm Gardening and Seed Growing, Francis Brill, 1872.

BURR, or Burr.—Field and Garden Vegetables of America, Fearing Burr, Jr., 1853.

GREG.—Cabbages and how to grow them, J. J. H. Gregory, 1870.

HEN.—Gardening for Profit, Peter Henderson, 1887; Les pl. pot.—Les plantes potagères, Vilmorin, Andrieux et Cie., 1883.

MORTON.—Cyclopedia of Agriculture, 1855.

VEG. GAR.—The Vegetable Garden, the English edition of *Les plantes potagères*, edited by William Robinson, 1885.

VIL.—*Les plantes potagères*, Vilmorin, Andrieux et Cie., 1883.

WHITE.—Gardening for the South, William N. White, 1868.

Additional abbreviations are employed as follows:

(d.) "from description"—applied to synonyms that have been identified from a printed description.

Dan.—Danish.

Flan.—Flanders.

Fr.—French.

Ger.—German.

Holl.—Holland.

Ital.—Italian.

Port.—Portuguese.

Syn.—Synonym.

When two or more foreign synonyms are given, the initial is generally substituted for the word expressing the kind of vegetable in the second and following names of each language. The same is true in certain cases in the English synonyms.

The effort has been made to use terms in the descriptions that should be as far as possible self-explanatory. A few of the words or phrases used, however, have been assigned a special meaning, and some others are introduced which have not often been used in horticultural descriptions. These are here explained:

Border.—Of the leaf, the part of the limb adjacent to the margin.

Club-shaped.—Shaped like a club, swollen at one end and constricted into a neck toward the other.

Cylindri-conical.— Said of root vegetables that are cylindrical for a part of their length and then taper to a point.

Dishing.— Said of leaves in the Cucurbitæ when the limb is depressed at the center, forming a funnel-like basin.

Foliage.— Refers chiefly to the aspect or amount of the leafage as a whole. The leaves, petioles, midribs and veins are considered as parts of the foliage.

Margin.— Of the leaf, the line bounding the contour.

Obovate.— Egg-shaped, with the narrower end toward the stem.

Præmorse.— Said of root vegetables that end abruptly at the lower end as if bitten off.

Root-circle.— In the bulb of the onion, the circular space at the bottom, occupied by the roots.

Striate.— Said of root vegetables to express the slight transverse ridges and depressions that extend partly or entirely about the root, as in many of the carrots.

In the article on the tomato, other words and phrases used with reference to this vegetable only are explained.

ARRANGEMENT OF THE VARIETIES.

The order of arrangement follows the classification, and is not strictly alphabetical. A given variety of which the name is known may most readily be found, therefore, by consulting the index of names and synonyms, which is appended for each vegetable separately, immediately after the last variety.

If, however, it is desired to name an unrecognized variety, it may be most readily done by consulting the synopsis which precedes the varieties of each vegetable.

As the varieties are classified, characters that are the same throughout a group, are usually omitted in the variety descriptions.

METHOD OF CLASSIFICATION AND SELECTION OF SAMPLES.

In the esculent root vegetables, the varieties are classified first, with reference to the form, and second with reference to the color of the roots.

In the other vegetables treated, the method of classification for each is stated at the commencement of the article.

With the exception of the radish, the samples used for description in all the vegetables were supposed to be fully developed. In the latter they were taken when of fair edible size.

THE GARDEN BEET.

Synopsis of Classification.

1. Root oblate or top-shaped:
    - A. Root red. Nos. 1–6 incl.
    - B. Root yellow. No. 7.
2. Root oval:
    - A. Root red. Nos. 8-9.
    - B. Root yellow. No. 10.
3. Root half long:
    - A. Root red. Nos. 11–13 incl.
    - B. Root yellow. No. 14.
4. Root long conical:
    - A. Root red. Nos. 15–20 incl.
    - B. Root yellow. No. 21.
    - C. Root black or blackish. Nos. 22-23.

DESCRIPTION OF THE VARIETIES.

1. Root oblate or top-shaped.

A. Root red.

No. 1. BASSANO, BRILL; BURR.

Syn. Early Flat Bassano, Burr; VEG. GAR.: Turnip-rooted Bassano, Burr: *Early Bassano*, Sib., '83: *Early Flat Bassano*, Hen., '87: Thor., '85, '87: Fr., Betterave rouge de Bassano, (d) Vil.: Ger., Plattrunde Bassano Salat-Rübe, Vil.: Plattrunde Bassano Runkle rübe, A. de Cl.

Root resembles in form the Egyptian beet, but is somewhat larger in size, grows deeper in the soil, has a larger tap-root, more rootlets, and more abundant foliage; well developed samples 5 or 6 in. in diameter, 3 to 3½ in. through the axis; like the Egyptian, the roots become irregular when full grown; surface generally smooth; skin grayish or russet above ground, clear rose red below; neck sometimes small and surrounded with a circle of scales, at others undefined, the entire crown being covered with small tufts of leaves;— foliage abundant, rather lively green, half erect; petioles rather short, washed with red; — flesh zoned with white and rose, sweet, tender and well flavored while young, becoming rather coarse and fibrous when full grown;— season medium.

A very productive variety of Italian origin; formerly the most popular early beet, but now largely superseded by the Egyptian and Eclipse.

Correctly figured in Les pl. pot., p. 40; Veg. Gar., p. 82.

LANDRETH'S VERY EARLY, Land., '84; Syn. *Landreth's Very Early Forcing*, Land., '85, appeared to be a variable strain of the Bassano, somewhat earlier, and with more scanty foliage.

PHILADELPHIA EARLY TURNIP, Land., '85, appeared to be a strain of the same, growing possibly a little larger, more highly colored and maturing a few days later.

No. 2. EARLY BLOOD TURNIP, Greg., '86; HEN.; Sib., '83; Thor., '87.

Syn. *Early Blood Red*, Land., '86: Early Blood Turnip Rooted, BURR: Early Turnip, Burr: Early Turnip Rooted, BRILL; WHITE.

Root short top-shaped, growing quite largely above ground; well developed samples 6 in. in diameter, 5 in. through the axis; skin dull purplish red; tap-root rather large; side-roots few; neck small;— foliage medium, rather strongly colored, particularly late in the season; petioles and veins deep carmine; — flesh blood red zoned with lighter, very crisp, tender and sweet; — season a few days later than that of the Bassano.

Formerly the most popular early beet, but now largely superseded by the Egyptian and Eclipse.

Numerous strains of this variety are extant. The following have been grown at the Station:

BASTIAN'S BLOOD TURNIP, HEN., '87; Thor., '87;—Syn. *Bastian's Early Blood Turnip*, Greg., '83, '86, '87; *Bastian's Extra Early*, Hen., '86; *Extra Early Blood Turnip*, Thor., '83.

Differs from the above, if at all, in being slightly earlier.

DEWING'S EARLY BLOOD TURNIP, Greg., '86, '87;—Syn. *Dewing's Extra Early Turnip*, Thor., '87: *Dewing's Improved Blood Turnip*, Sib., '83; HEN., '87.

Root rather deeper red than in the Early Blood Turnip, and rather more symmetrical.

EARLY BLOOD TURNIP IMPROVED, Fer., '83;—Syn. *Burpee's Early Turnip*, Burpee, '86.

Tops rather more scanty than in the Early Blood Turnip.

HATCH'S BLOOD, Thor., '85;—Syn. *Hatch's Blood Turnip*, Greg., '83, appeared scarcely distinct from Early Blood Turnip.

The French variety BETTERAVE ROUGE ROND PRECOSE;—Syn. *Turnip-rooted Red*: Ger., *Runde dunkelrothe frühe Salat-Rübe* of Les plantes potagères very closely resembles, if it is not identical with, the Early Blood Turnip.

No. 3. ECLIPSE, Greg., '87; HEN.; Thor., '83, '87.

Syn. *Eclipse Turnip*,* Greg., '85: *New Eclipse*, Burpee, 86.

Root roundish, somewhat oblate, very regular, becoming quite oblate and somewhat irregular when full grown, growing almost entirely above ground; tap-root clearly defined; well developed samples 3½ in. in diameter, 2½ in. through the axis; surface very smooth, without side-roots; skin blackish red below ground, russet and slightly scaly above; neck very small;—foliage slightly more abundant than that of the Egyptian, deep purple, sometimes inclining to green; petioles and veins carmine.

Of superior quality; — in season slightly later than Egyptian.

"Market gardeners in the vicinity of New York claim that it is bound to be the leading market sort." Hen.

No. 4. EGYPTIAN, Greg., '87.

Syn. *Dark Red Egyptian*, Sib., '83: Early Dark Blood Egyptian, BRILL, (d): Egyptian Dark Red Turnip Rooted, VEG. GAR.; Vil.: Egyptian Red Turnip, Vil.: *Extra Early Egyptian*, Thor., '87: *New Dark Egyptian Turnip*, Thor., '85: *New Round Egyptian or Athens*, Dam., '86: Fr., Betterave rouge noir plate d' Egypt. VIL.: Ger., Egyptische oder Athener plattrunde schwarzrothe Salat-Rübe, Vil.: Schwarzrothe aus Ægypten Runkel-rübe. A. de Cl.

Root oblate, much flattened, sometimes slightly concave below, regular while young, becoming distorted when full grown; growing almost entirely above ground; well developed samples 3 to 5 in. in diameter; surface very smooth; skin dull, dark, purplish red; tap-root remarkably slender and well defined; neck small; — foliage scanty or medium, reddish brown, more or less mixed with green; leaves more or less waved, borders finely undulate, petioles long and slender, rich red;— flesh dark purplish red, fine-grained, crisp, tender and sweet.

This is generally considered to be the earliest variety of garden beet, and is perhaps at present the most popular one for market. It is very productive for an early beet, as owing to its small foliage, the rows will bear planting closer than most other varieties, and on rich soil, the roots will develop even when considerably crowded.

Introduced into this country about 1869; — of Italian origin.

Correctly figured in Les pl. pot., p. 40; Veg. Gar., p. 81.

CROSBY'S EARLY EGYPTIAN, Greg., '85. A strain of the Egyptian of superior quality, producing a less flattened root, without being less early.

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* The ECLIPSE TURNIP of the Vegetable Garden does not answer to this description.

No. 5. RED FLAT TREVISE, Vil., '84.

Syn. *New Early Red Flat Turin*, Thor., '87: *New Round Treviso*, Dam., 86: Trevise Early Salad, or Turin Red Spring, VEG. GAR.: Fr., B. rouge á salade très hâtive de Trévise, or B. rouge printanière de Turin, Vil.

Root short top-shaped, sloping abruptly to the small or medium neck; very irregular when full grown, growing largely beneath the soil; well developed samples 2½ in. in diameter in both directions; surface more or less striate, side roots few; skin deep dull dark red in the lower half, light brown, or russet above; —foliage rather scanty, rich glossy purple; leaves slightly waved, borders finely undulate;— flesh ringed with blackish red and scarlet.

Nearly as early as the Egyptian, and said to be of better quality for use while young. In our trials it bursted badly when left in the ground until full grown and proved far less productive than the Egyptian.

No. 6. ROUND EARLY RED NAPLES, Dam., '86.

Resembles the Eclipse though less regular in form, with less highly colored flesh; well developed roots 5 in. in diameter, 4 in. through the axis; neck small; tap-root well defined, slender; — foliage medium, pale green; petioles and veins striped and tinged with carmine.

B. Root yellow.

No. 7. YELLOW TURNIP, Vil.

Syn. *Early Yellow Turnip*, Hen., '87; Thor., '83, '87: Orange, Vil.: *Round Yellow Turnip*, Greg., '86, '87: Yellow or Orange Turnip, VEG. GAR.: Yellow Turnip-Rooted BURR: Fr., Betterave jaune ronde sucrée, VIL.: Ger., Gelbe runde süsse Salat-Rübe, Vil.

Root roundish, inclining to top-shaped; growing mostly above ground, with a thick tap-root; well developed samples 4½ in. in diameter, 5 in. through the axis; surface usually very smooth; skin orange or rich yellow below ground, brown above, rough and scaly about the rather large neck; — foliage abundant; leaves rather short and broad, yellowish green, wrinkled and undulate; petioles and veins yellow; — flesh zoned with pale yellow and white, taking when cooked, an orange tint; — season medium.

Little grown for the table, as its color is unpopular.

Correctly figured in Les pl. pot., p., 41; Veg. Gar., p. 83.

2. Root oval.

A. Root red.

No. 8. DELL'S BLACK-LEAVED, Vil.

Syn. Dell's Crimson, Vil.: Dell's Dark Crimson Dwarf, VEG. GAR.: *Dell's Flower Garden*, Sib., '84: Osborn's Selected Garden, Vil.: Fr., Betterave rouge de Dell, VIL.: Betterave rouge naine de Dell à feuille noir, Veg. Gar.: Ger., Dell's schwarzrothe Runkelrübe, A. de Cl.

Resembles the Pear-Shaped in many respects, but the root inclines more to conical, and the foliage is more abundant; the leaves more blistered and less thick.

Sometimes grown as an ornamental beet.

Correctly figured in Les pl. pot., p. 37; Veg. Gar., p. 79.

The SAINT OSYTH, Sib., '84, may be called a strain of the above, and is apparently about intermediate between this and the Pear-Shaped.

No. 9. PEAR-SHAPED, Vil.

Syn. *Dark Red Pyriform or Strasbourg*, Vil., '84: *Erfurt Black Red*, Ben., '83: Half Long Dark, Vil.: Intermediate, Veg. Gar.: *Ne Plus Ultra*, Thor., '85: Strasbourg Pear-Shaped, VEG. GAR.: Fr., *Betterave Piriforme de Strasbourg*, VIL., '84: B. rouge de Strasbourg, Vil.: Ger., Schwarzrothe birnförmige Salat-Rübe, Vil.

Root short fusiform or oval, growing usually below ground; well developed samples $3\frac{1}{2}$ in. in diameter, 7 in. through the axis; surface more or less indented with shallow depressions, sometimes slightly striate, or marked with narrow light brown stripes, very rough and scaly about the rather large neck; skin very dark purplish red, light brown about the neck; side-roots numerous but very short;—foliage abundant, very dark purple, inclining to black; leaves somewhat waved, with slight appearance of blistering, border undulate; petioles same color as the limb;—flesh deep dull red, with rings of reddish pink, the depths of the shades varying in different samples.

The root of this variety is more deeply colored than that of any other, but it is only moderately productive. In season it is intermediate.

Correctly figured in Les pl. pot., p. 39; Veg. Gar., p. 80.

B. Root yellow.

No. 10. GOLDEN TANKARD, Land., '84, '85.

A very symmetrical variety; roots regularly oval, growing about one-third above ground; well developed samples 4 in. in diameter, 5 or 6 in. through the axis; surface usually remarkably smooth, a little striate below, and hollowed where the side-roots are attached; the latter are rather numerous in the lower half, but usually small; skin dull orange below ground, shading to yellowish brown about the small neck;—foliage rather scanty; leaves clear green, borders usually rather finely undulate; petioles, midribs and larger veins greenish white;—flesh zoned with white and lemon color;—season medium.

3. Root half long.

A. Root red.

No. 11. HALF LONG BLOOD, BURR; Land., '86; Thor., '85.

Syn. Dwarf Blood Burr: *Dwarf Deep Blood Red*, Vil., '84: Dwarf Red, VEG. GAR.: Fine Dwarf Red, Burr: Early Half Long Blood, Burr: Nutting's Selected Dwarf Red, WHITE; Vil.: Fr., *Betterave rouge naine*, VIL., '84. Ger., Schwarzrothe zwerg Salat-Rübe, Vil.

Root regular conical, sloping to the slender neck, growing mostly beneath the soil; well developed samples 3 in. in diameter, 6 to 10 in. long; surface very smooth, slightly striate in places; side-roots very small and few; skin dark dull red, light brown or russet about the neck;—foliage abundant, very spreading; leaves dark glossy purple, with a slight metallic luster in some plants, much longer than broad, somewhat blistered, border slightly undulate;—flesh ringed with blackish red and scarlet;—season intermediate.

A sweet, well flavored, good-keeping variety, by many considered superior in quality to the Long Blood.

Correctly figured in Les pl. pot., p. 37; Veg. Gar., p. 79.

BASTIAN'S HALF LONG BLOOD, Greg., '83, '86, '87; a strain of the above having very dark colored flesh.

HENDERSON'S PINEAPPLE, Greg., '83, '87, Syn. Half Long or Pineapple, BRILL; very closely resembled the Half Long Blood. The root rounded rather more gradually to the neck, the side-roots were rather more numerous, and the color of the flesh was perhaps slightly deeper.

OMEGA, Till., '85, appeared to be a strain of the Half Long Blood, differing from it in being a little more slender, having the surface more striate, with more side-roots and with more scanty foliage.

PERFECTION, Everitt, '85. A strain of the Half Long Blood with a rather more symmetrical root.

No. 12. VEITCH'S CHELSEA, Ben., '86.

Root short conical, rounding or tapering to a slender neck, and growing 2 to 3 in. above ground; well developed samples 11 in. long, 4 in. in diameter; surface somewhat irregular, striate in the lower half; skin deep, dull red;—foliage very abundant, leaves rich glossy purple, shading to green in some plants;—flesh very deep red, ringed with paler red.

Possibly only a strain of Whyte's Black.

No. 13. VICTORIA, Thor., '84, '85; VIL.

Root very short conical, sloping to a rather small neck, growing slightly above ground; well developed samples 4 in. in diameter, 6 in. through the axis; surface usually smooth, often somewhat furrowed in the larger specimens; skin very deep red, approaching black;—foliage very abundant; leaves very large, somewhat resembling those of the ornamental chards, deep glossy purple, with more or less metallic luster; petioles carmine;—flesh ringed with dark and pale red, with some white spots in occasional samples.

"Less remarkable for its merit as a vegetable than for the peculiar metallic appearance of its foliage; it is used as much as an ornamental plant as a vegetable." Les pl. pot., p. 41.

B. Root yellow.

No. 14. YELLOW CASTLENAUDARY, BURR; VEG. GAR.; Vil., '84.

Syn. Small Yellow, Vil.: Fr., *Betterave jaune de Castlenaudary*, Vil., '84.

Root short conical, sloping to the rather small neck, growing below ground; well developed samples 6 in. long, 2½ in. in diameter; surface slightly striate; skin orange in the lower half, shading to brown above; tap-root often branched;—foliage abundant, spreading; leaves large, green, somewhat blistered with undulate borders; petioles short, rich yellow;—flesh ringed with cream-colored and translucent zones.

"An excellent table beet, being tender, yet firm, and very sweet when boiled." Burr.

4. Root long conical.

A. Root red.

No. 15. CROWN PRINCE, Thor., '85.

Root rather long regular conical, sloping to the small neck, growing 1 or 2 in. above ground; well developed samples 11 in. long, 3 in. in diameter; surface somewhat striate; side-roots mostly very small, on opposite sides, but not in furrows; skin dull, dark red, inclining to gray about the neck;—foliage abundant, rather erect; leaves shading from deep glossy purple to clear green, borders slightly undulate; petioles and veins reddish purple;—flesh ringed with dull dark, and pale pinkish red.

No. 16. DRACŒNA LEAVED, Vil., '87.

Syn. Fr., *Betterave rouge à feuille ornementale*, Vil., '87.

Root long conical, regular, growing 2 to 3 inches above ground; well developed samples 2½ in. in diameter, 10 in. long; deep dull red; surface smooth, not furrowed, striate in the lower half; side-roots rather numerous; neck small;—foliage very distinct; leaves very narrow, on long petioles, curving downward gracefully and becoming entirely of a rich, deep purple color late in the season;—flesh very deep, blood red, circled with a somewhat paler shade.

No. 17. LONG BLOOD, BURR; WHITE.

Syn. Common Long Blood, Burr: *Long Blood Red?, Land.*, '84; *Long Dark Blood,* Ferry, '83; *Long Red?,* Thor., '85.*

Root long conical, rounding to the rather large neck, growing mostly beneath the soil; well developed samples 12 in. long, 2½ in. in diameter; surface more or less striate, with a row of rootlets extending nearly the whole length on either side; skin deep dull red;—foliage medium, or rather scanty; leaves rich glossy purple; little waved, margins finely undulate; petioles pale red;—flesh deep red, more or less prominently marked with stripes of paler red;—season late.

Formerly one of the most popular beets for winter use, now largely superseded by the Long Smooth Blood.

No. 18. LONG SMOOTH BLOOD, BRILL; HEN.; Thor., '85.

Syn. Early Long Blood (d), WHITE: Improved Long Blood, BURR: Large Blood Red (d), VEG. GAR.; Vil.: *Long Smooth Blood Red,* Ev., '85; Hen., '87; Thor., '85: *Long Smooth Dark Blood,* Greg., '86: Fr. Betterave rouge écarlate, Vil.: B. rouge grosse (d), Vil.: B. rouge longue, Vil.: Ger., Lange blutrothe Salat-Rübe, Vil.

Developed from the Long Blood, than which it is of much larger size, of better quality, and a week earlier. Root cylindrical or long conical, rounding gradually to the rather large neck, growing ⅓ to ½ above ground, often bent and distorted and sometimes forked below; well developed samples 12 to 18 in. long, 2 to 4 in. in diameter; surface considerably furrowed and somewhat striate; skin dull dark red;—foliage very abundant, leaves varying from dark rich glossy purple to green, with carmine petioles, ribs and veins;—flesh zoned with very deep, almost blackish red, and bright crimson.

At present considered the standard market beet for winter use.

Correctly figured in Les pl. pot., p. 38; Veg. Gar., p. 80.

No. 19. PINEAPPLE, Hen., '86, '87.

Syn. *Henderson's Dwarf Pineapple,* Sib., '83: Pineapple Short Top, BURR.

Root long conical, rather slender, growing slightly above ground; well developed samples 2½ in. in diameter, 9 in. long; skin very deep dull red; neck small;—foliage remarkably scanty; leaves strongly inclining to purple, becoming intense purple late in the season, long narrow, with undulate borders, on rather short, carmine petioles;—flesh intense, deep blood red, sweet, tender, and of superior quality for table use.

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* This appears to be the *Betterave rouge longue lisse* of Vilmorin, Synonyms, Long Smooth Blood Red; Long Smooth Rochester; Ger., Lange dunkelrothe amerikanische Salat-Rübe and the American Long Smooth Blood-Red, or Radish beet of the Vegetable Garden.

SHORT'S PINEAPPLE, VIL.—Syn. Henderson's Pineapple, Pineapple Dwarf Red appears to closely resemble the above with the exception that it has orange, instead of carmine petioles.

No. 20. COVENT GARDEN, Vil.

Syn. Covent Garden Red, VEG. GAR.: *Red Covent Garden*, Vil. '84: Fr., *Betterave de Covent-Garden*, VIL., '84.

Root very slender conical, tapering to a long slender tap-root, and rounding to a very small neck, growing below ground; well developed samples 1½ in. in diameter, 7 in. through the axis; surface somewhat striate, rather rough from the presence of abortive side-roots when full grown; skin dull deep red;—foliage extremely scanty; leaves deep purple, slightly glossy, little waved, borders finely undulate; petioles deep purple, with a paler stripe above;—flesh ringed with deep red and scarlet.

This seems admirably adapted for use while young, but quite unsuited to winter use unless sown very late. Its very scanty foliage, and slender root would seem to make it valuable for forcing,

B. Root yellow.

No. 21. LONG YELLOW, VEG. GAR.; Vil., '84.

Syn. Large Yellow, Vil.: Orange, Vil.: Fr., *Betterave jaune grosse*, VIL., '84: B. jaune longue, Vil.: Ger., Grosse lange gelbe Salat-Rübe, Vil.: Lange gelbe Salat-Rübe, A. de Cl.

Root long conical, or cylindri-conical, growing ⅓ to ½ above ground; well developed samples 12 in. long, 2½ in diameter; surface somewhat striate, often furrowed longitudinally along the line of the very short side-roots; skin orange in the lower half, shading to light brown above; neck large;—foliage abundant, inclining to erect; leaves green, slightly waved, with somewhat undulate borders; petioles midribs and veins pale yellowish green; — flesh zoned with white and translucent rings.

The beet "principally cultivated by the cow keepers of Paris and vicinity, on account of its reputed high nutritious and milk-producing qualities. * * * The most productive, and one of the best yellow-fleshed kinds." Les pl. pot., p. 41.

Correctly figured in Les pl. pot., p. 41; Veg. Gar., p. 82,

C. Root black, or blackish.

No. 22. BLACK-SKINNED, BURR (credited to Vil.),

Syn. *Crapaudine*, Ben., '83; VIL.: Oak Bark-Skinned, Burr: Rough Skinned, VEG. GAR.; Vil.: Fr., Betterave écorce, Vil.: B. écorce de chêne, Vil.: B. noire écorce de sapin, Vil.: B. précose noire, Vil.: Ger., Dunkelrothe rauhhäutige Crapaudine Salat-Rübe, Vil.

Root conical, often irregular, growing beneath the soil; well developed samples 3 in. in diameter, 10 in. long; skin resembling that of a black winter radish, being much cracked, reminding one of the bark of young ash or hickory trees, whence its name; side-roots rather numerous; neck medium or large;—foliage medium, rather spreading; leaves mostly green, borders somewhat undulate; petioles red;—flesh deep red, zoned with paler red, or white.

Rather early, of fine flavor, good for summer use.

Correctly figured in Les pl. pot., p. 36; Veg. Gar., p. 78.

No. 23. WHYTE'S BLACK, Vil.; VEG. GAR.

Syn. Barrett's Crimson, Vil.: Oldacre's Blood Red, Vil.: Osborne's Improved Blood Red, Vil.: Perkin's Black, Vil.: Whyte's Dark Crimson, BURR: Fr., *Betterave rouge foncé de Whyte*, VIL., '84: Ger., Whytes schwarzrothe Runkle-Rübe, A. de Cl.

Root conical, tapering abruptly, or rounding to the medium neck, often somewhat furrowed longitudinally, growing below ground, or in some cases 1 or 2 in. above; well developed samples 9 in. long, 3 in. in diameter; surface somewhat striate; skin of a peculiar dark grayish or leaden color by which the variety may be distinguished, light brown or russet in the part above ground;—foliage rather abundant; leaves deep purple in some plants, varying through intermediate shades to green in others, borders somewhat undulate; petioles deep purple or carmine; flesh ringed with very deep dull red and scarlet, the shades varying somewhat in different roots.

One of the best varieties for winter and spring use, as it keeps remarkably well, and is of excellent quality.

Correctly figured in Les pl. pot., p. 38; Veg. Gar., p. 79.

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THE CARROT.

SYNOPSIS OF THE CLASSIFICATION.

1. Root distinctly pointed.
   A. Root long — the length exceeding four times the diameter.
      * Root white. Nos. 1-4 incl.
      † Root yellow. Nos. 5, 6.
      ‡ Root orange or red. Nos. 7-11 incl.
      ‖ Root purple. No. 12.
   B. Root half-long — the length not exceeding four times the diameter.
      * Root white. No. 13.
      ‡ Root orange or red. Nos. 14-18 incl.
2. Root distinctly præmorse, (blunt at the lower end.)
   A. Root long — the length exceeding four times the diameter.
      ‡ Root orange or red. No. 19.
   B. Root half-long — the length exceeding two, but not exceeding four times the diameter.
      ‡ Root orange or red. Nos. 20-24 incl.
   C. Root very short — the length not exceeding twice the diameter.
      ‡ Root orange or red. Nos. 25-28 incl.

DESCRIPTION OF THE VARIETIES.

I. Root distinctly pointed.

A. Root long — the length exceeding four times the diameter.

*** Root white.**

No. 1. LONG WHITE, Greg., '86; Thor., '85.

Syn. Common White, Burr.

Root long conical, usually irregular; growing 2 to 4 in. above ground, well developed samples 2 in. in diameter, 10 in. long; skin white below ground, dull pale green above, sometimes tinged with brown about the neck, which is large, and never surrounded by a hollow; surface little striate; side roots generally numerous, long, but very slender; — foliage very abundant, inclining to erect; — flesh white, core large, translucent cream color; — season late.

An old variety now largely superseded by the White Belgian, which is probably a development from it.

No. 2. ORTHE, VEG. GAR.

Syn. *White Green-Topped d' Orthe*, Vil., '84: Fr., *Carotte blanche à collet vert d' Orthe*, Vil., '84.

A strain of White Belgian differing from it chiefly in growing less above ground and in having a shorter, thicker root, from which cause it may be more readily pulled. It originated with M. J. Roussel, of Orthe, France, who raised it from seed of selected plants of the White Belgian.

Correctly figured in Les pl. pot., p. 69; Veg. Gar., p. 169.

No. 3. TRANSPARENT WHITE, Ben., '83; VEG. GAR.; Vil.

Syn. White Belgian Horn, BURR: Fr., Carotte blanche transparente, VIL.: C. translucide, Vil.

Root conical, regular, growing beneath the soil; well developed samples 2 to 3 in. in diameter, 7 to 9 in. long; skin clear white; surface very smooth; neck small, surrounded by a hollow;—foliage abundant;—flesh white, with a rather large, translucent core;—season late.

A French garden variety distinguished chiefly for the peculiar pure white color of its skin and flesh.

No. 4. WHITE BELGIAN, BURR; Thor., '87; VEG. GAR.; Vil.

Syn. Green Top White, Burr: *Large White Belgian*, HEN.; Sib., '83: *White Green Top*, Vil., '84: Fr., Carotte arbre, Vil.: *C. blanche à collet vert*, VIL., '84: Ger., Sehr grosse weisse grünköpfige Riesen Möhre, Vil.: Holl., Lange witte belgische wortel, Vil.: Span., Zanahoria blanca de cuello verde, Vil.

Root conical or cylindri-conical, growing about $\frac{1}{3}$ above ground, rounding to a large neck, which is not surrounded by a hollow; well developed samples 3 in. in diameter, 12 in. long; skin white in the part below ground, green or brown above; surface striate;—foliage very abundant;—flesh white, tending to citron yellow at the heart; not sufficiently fine for table use;—season late.

This is generally considered the most productive variety of carrot, and is the one most grown for stock; though thought by some to be less nutritious than the Long Orange.

Correctly figured in Les pl. pot., p. 69; Veg. Gar., p. 168.

† Root Yellow.

No. 5. YELLOW BELGIAN, Burr; HEN.

Syn. *Large Yellow Belgian*, Sib., '83: Long Orange Green Top, Veg. Gar.: Long Red Belgian, BURR: *Orange Belgian*, VEG. GAR.; Vil., '84: Yellow Belgian Green Top, Vil.: Yellow Green Top Belgian, Burr: Fr., Carotte jaune à collet vert, Vil.: C. rouge longue à collet vert, VIL.: *C. rouge ou jaune longue*, Vil., '84: Ger., Sehr grosse rothe grünköpfige Möhre, Vil.: Holl., Lange gele belgische wortel, Vil.

Root cylindri-conical, growing about $\frac{1}{4}$ above ground, rounding to a large neck which is not surrounded by a hollow; well developed samples 2 in. in diameter, 12 in. long; skin pale orange below ground, green above; surface striate; side roots considerably developed;—foliage very abundant;—flesh orange, or reddish orange, core rather large;—season late.

A very productive variety largely grown for feeding stock, and considered very nutritious.

Correctly figured in Les pl. pot., p. 66; Veg. Gar., p. 166.

No. 6. YELLOW INTERMEDIATE, Ben., '86.

A long conical variety closely resembling the Long Lemon, and possibly identical with it.

‡ Root orange or red.

No. 7. ALTRINGHAM, Burr; Hen., '87; VEG. GAR.; WHITE.

Syn. Altrincham, BURR (credited to Law); Vil.: *Altringham Long Red*, Sib., '83: Long Red Altringham, Burr (credited to Vil.): *Long Scarlet Altringham*, Vil., '84: Fr., *Carotte rouge longue d'Altringham*, VIL., '84.

Root slender cylindri-conical, often quite irregular, growing 1 to 3 in. above ground; well developed samples 2 in. in diameter, 14 in. long; skin reddish orange below ground, purple or bronze-colored above; surface usually deeply striate; neck small, not set in a hollow;—foliage rather abundant; leaves long but not large nor very numerous;—flesh red throughout, or with a very small heart;—season late.

Of excellent quality, but at present little grown, possibly because of its growing so deep in the soil.

"According to Lawson, it is easily distinguished from the Long Orange by the roots growing more above ground, by its more convex or rounded shoulders, and by its tapering more irregularly, and terminating more abruptly." Burr.

"Derives its name from a place called Altrincham, in Cheshire, Eng., where it is supposed to have originated." Thompson.

Correctly figured in Les pl. pot., p. 66; Veg. Gar., p. 166.

No. 8. LONG ORANGE, BRILL; BURR; Greg., '87; Sib., '83; Thor., '85, '87; VIL.; WHITE.

Root long conical, rather irregular, growing almost entirely below ground, rounding abruptly to a large neck, which is surrounded by a well marked hollow; well developed samples $2\frac{1}{2}$ to 3 in. in diameter, 10 to 12 in. long; skin orange; surface striate, often quite uneven, side-roots few, though sometimes quite large;—foliage very abundant;—

flesh reddish vermillion, or orange, the core lighter and large in proportion to the size of the root;—season late.

Largely cultivated in this country for agricultural purposes.

No. 9. LONG ORANGE IMPROVED, HEN.

Syn. *Improved Long Orange*, Bliss, '83; Greg., '87.

A strain of Long Orange of somewhat deeper color than the ordinary variety. In our tests it proved very productive, but quite variable in form.

Correctly figured in Gar. for Profit, p. 172.

No. 10. LONG SURREY, BURR; VEG. GAR.

Syn. Chertsey, Vil.: James' Scarlet, Burr: Long Red, Burr; Veg. Gar.: Long Red Brunswick (d), Burr: *Long Red Surrey or Long Orange*, Vil., '84: Red Surrey, Vil.: Studley (d), BURR; Vil.: Fr. Carotte longue de Croissy, Vil.: *C. rouge de Flandre*, VIL.: *C. rouge longue*, VIL., '84: C. rouge longue de Toulouse, Vil.: Ger., Frühe lange rothe Möhre, Vil.: Roode Frankforter Wortel, Vil.: Span., Zanahoria encarnada larga, Vil.

Much resembles the Long Orange. The root is rather more slender and deeper colored.

A very hardy and productive variety much grown in Europe for garden and field culture. In France the plants are often covered in the fall with a thin layer of straw or leaves, and left during winter to be pulled as needed.

No. 11. SAINT VALERY, VEG. GAR.

Syn. *Long Red Saint Valery*, Vil., '84: Fr., *Carotte rouge longue de Saint Valery*, VIL., '84.

Root regular, conical, rounding slightly to a small neck which is not surrounded by a hollow; well developed samples 2 in. in diameter, 8 or 10 in. long; skin orange, sometimes dark reddish brown about the neck, and for a short distance below; surface usually distinctly striate;—foliage very abundant;—flesh reddish orange, core rather small, not very distinct;—season late.

"Along with a handsome appearance and good quality, it combines the distinguishing properties of both good kitchen-garden and good field carrots—that is great productiveness, and at the same time a fine, regular shape and thick, sweet tender flesh." Vil.

Correctly figured in Les pl. pot., p. 67; Veg. Gar., p. 167.

|| Root purple.

No. 12. PURPLE, Ben., '83; BURR; VEG. GAR.; Vil.

Syn. Blood Red, Burr; Veg. Gar.; Vil.: *Violet*, Ben., '83: Fr., Carotte noire de l'Inde, Vil.: C. violette, Vil.: Ger., Violette Möhre, Vil.

Root slender conical or fusiform, growing beneath the soil; well developed samples two in. in diameter, ten to twelve in. long; skin dark purple, the shade varying somewhat in different samples; surface usually more or less striate, the slight ridges varying in size in different parts of the circumference, and white where most enlarged; side roots white; neck rather large;—foliage abundant, erect, and with the flowers sometimes tinged with purple;—flesh purple except the heart, which is usually rather large, and colored yellow, fine grained, sweet and well flavored;—season late.

This variety, which appears rather poorly fixed, does not keep well, and when grown on rich soil, frequently runs to seed the first season. It is quite largely grown in some warm countries, but on the whole, must be considered more curious than useful. The flesh imparts an unpleasant brown color to soups and other dishes in which it is used. The plant is said to flourish better than other varieties on wet, heavy soils.

B. Root half long—the length not exceeding four times the diameter.

* Root white.

No. 13. VOSGES WHITE, VEG. GAR.

Syn. *Large Short Vosges*, Vil., '84: Short White, Burr: Fr., *Carotte blanche des Vosges*, Vil., '84: C. Violette, VIL. Ger., Dicke vogesische Möhre, Vil.

Root short conical, growing below ground; well developed samples 4 in. in diameter, 8 in. through the axis; skin white, shading to pale green about the neck, which is small, and often surrounded by a hollow; surface regular, little striate;—foliage abundant, low and spreading;—flesh white or cream colored, sometimes slightly hollow with a large yellowish, irregular, translucent core.

A field carrot adapted to shallow soils. It is productive, easily pulled, and keeps well, but lacks sweetness, and has a rather disagreeable strong taste which unfits it for culinary use.

Correctly figured in Les pl. pot., p. 70; Veg. Gar., p. 168.

‡ Root orange or red.

No. 14. DANVERS, Fer., '83, '84; Greg., '87; HEN.; Thor., '85, '87.

Syn. *Danvers Orange Half Long,* Land., '84, '85.

A strain of the Half Long Pointed carrot extensively grown about Danvers Mass., and in some other localities. It appears closely allied to the English variety, James' Intermediate, but as grown at the Station has not seemed well fixed, as the roots were sometimes blunt and sometimes pointed. It is considerably longer than the Half Long Pointed, and hence more productive, while easier to dig than the Long Orange.

Well figured in Gardening for Profit, (ed. 1887) p. 172.

No. 15. ENGLISH HORN, VEG. GAR.; Vil., '84.

Syn. *Early Half Long Pointed,* Hen., '87: Early Half Long Scarlet, BURR; Veg. Gar.: Early Half Long Scarlet (pointed rooted), HEN.: *Half Long Pointed Rooted,* Vil., '84: Half Long Red, Burr (credited to Vil.): *Half Long Red Pointed,* Thor., '83, '85, '87: *Pointed Rooted Early Scarlet Horn,* Land., '86: Fr., *Carotte rouge demi-longue pointue,* VIL., '84: Ger., Halb-lange Zugespitze Treib-Möhre, Vil.: Holl., Half-lang hoornsche wortel —, Vil.: Port., Cenoura d'Hollanda vermelha mediana, Vil.

Root half-long conical, growing mostly below ground, regular, rounding slightly to a rather large neck, which is surrounded by a distinct but narrow hollow; well developed samples 2½ in. in diameter, 7 in. long; skin reddish orange, shading to dull green about the neck; surface striate, with a few rather long, but very slender side-roots; tap-root slender, white;—foliage abundant;—flesh reddish orange, with a perceptible, but not very distinct core;—season intermediate.

A productive variety of good quality.

Correctly figured in Les pl. pot., p. 62; Veg. Gar., p. 163.

No. 16. FLANDERS, VEG. GAR.; Vil.

Syn. Flanders Large Pale Scarlet, BURR: Flanders Pale Red, Burr: *Large Pale Red Flanders,* Vil., '84: Long Orange, Vil.: Sandwich, Vil.: Fr., *Carotte rouge pâle de Flandre,* VIL., '85: Ger., Blassrothe dicke flandrische, Möhre, Vil.

Root irregular conical, growing below ground, rounding more or less abruptly to the small or medium neck; well developed samples 2½ in. in diameter, 9 in. long; skin orange, green or dull purple about the neck; surface deeply striate, with occasional cream-colored warty excrescences and more or less side-roots;—flesh varying in color from yellow to reddish orange, with a large, very distinct, rayed core;—season late.

An old variety from Flanders, seldom grown in this country, though it has merit as a field carrot, as it is rather early, very productive, and keeps remarkably well

Correctly figured in Les pl. pot. p. 67; Veg. Gar., p. 167.

No. 17. NEW INTERMEDIATE, Hen., '87.

This appeared to be an improved form of James' Intermediate, growing more symmetrical, and deeper in the soil, with a very small neck; surface regular, but somewhat striate; side-roots little developed; well developed samples 2 in. in diameter, 8 in. long. A very productive variety; — season intermediate.

The cut in Henderson's catalogue for 1887 represents the form correctly, but the surface is not so smooth as indicated.

No. 18. JAMES'S INTERMEDIATE, H. & W., '85; Sib., '83; VEG. GAR.; VIL., '84.

Syn.. New Intermediate? (d), Burr.

Root conical, rounding abruptly to a medium or rather small neck, which is usually not surrounded by a well marked hollow; well developed samples 2½ in. in diameter, 8 in. long; skin orange, green or dark brown about, and sometimes considerably below the neck; surface striate, side roots considerably developed; — foliage very abundant; — flesh rich orange with a more or less distinct core; fine-grained, well flavored, and while young, good for table use; — season intermediate.

"Evidently an improved form of the Half Long Red carrot, but as it has now been a good while in very general cultivation, it has undergone a considerable amount of modification, in consequence of which it exhibits at the present day numerous diversities of character, in different districts. * * * * Up to the present time, this is the most extensively cultivated variety in England, both in fields and gardens." Veg. Gar.

2. Root distinctly præmorse, (blunt at the lower end.)

A. Root long, the length exceeding four times the diameter.

‡ Root orange or red.

No. 19. CORELESS LONG RED, VEG. GAR.

Syn. *Long Red Without Core*, Vil., '84: Fr., *Carotte rouge longue sans cœur*, VIL., '84.

Root distinctly cylindrical, rounding to both ends, often irregular in outline; well developed samples 1½ in. in diameter, 9 in. long; skin orange, dark brown about, and sometimes slightly below the neck, which is small, and sometimes surrounded by a hollow; surface uneven, often very deeply and densely striate; — foliage scanty; — flesh red, melting, sweet and fine-flavored; — season intermediate.

This is especially a garden variety.

Correctly figured in Les pl. pot., p. 65; Veg. Gar., p. 166.

B. Root half long — the length exceeding two, but not exceeding four times the diameter.

‡ Root orange or red.

No. 20. CARENTAN, Thor., '87.

Syn. *Carentan Half Long*, Thor., '85: Early Carentan, VEG. GAR.: Early Half Long Scarlet Carentan, HEN.: *Half Long Early Carentan*, Vil., '84: *Hal Long Scarlet Carentan*, Sib. '83: Fr., *Carotte demi-longue sans cœur de Carentan*, VIL., '84.

Root cylindrical, regular, inclining to præmorse conical, growing almost entirely below ground, rounding very abruptly to the very small neck, which is set in a more or less distinct hollow; well developed samples 2 in. in diameter, 6 in. long; skin orange, except a small white patch above the tap-root, and a brown or greenish one about the neck; surface usually more or less deeply striate; tap-root very clearly defined, slender, white; — foliage very scanty; — flesh red throughout; — season intermediate.

Distinguished from the Nantes carrot in being more nearly cylindrical, having no core, and by its more scanty foliage.

"Excellent for forcing, and for fine quality and perfect shape can hardly be surpassed." Hen.

Correctly figured in Les pl. pot., p. 63; Veg. Gar., p. 164.

No. 21. CHANTENAY STUMP-ROOTED, Vick, '87.

Syn. *Chantenay Half Long Scarlet*, Greg., '87: *Chantenay Half Long Scarlet Stump-Rooted*, Vil., '87: Fr., *Carrote rouge demi-longue de Chantenay*, Vil., '87.

Resembles the Early Nantes, but is somewhat thicker toward the neck, grows more above ground and is more productive; very symmetrical in form; neck small or medium, surrounded by a hollow; skin orange, brown about, and often for some distance below the neck.

In season it is intermediate, and is specially recommended for table use. It is of French origin, and was first offered in this country in the spring of 1887.

No. 22. EARLY NANTES, VEG. GAR.; Vil.

Syn. *Half Long Scarlet Nantes*, Sib., '83; Vil., 84: Fr., *Carotte demi-longue Nantes*, VIL., '84: Ger., Halblange stumpfe Nantes Möhre, Vil.

A strain of the Half-Long Blunt Scarlet, a little less tapering, rather smaller in diameter and more regular in form; flesh red throughout, almost entirely without core, very sweet and excellent for garden culture. Its finest qualities, however, are only brought out with the best treatment.

Correctly figured in Les pl. pot., p. 63; Veg. Gar., p. 164.

No. 23. HALF LONG BLUNT SCARLET, VEG. GAR.

Syn. *Half Long Red (Stump-Rooted)*, HEN., '87: *Half Long Scarlet (Stump-Rooted)*, Vil., '84, '85; Thor., '83, '87: *Half Long Stump Rooted*, Thor., '85: Fr., *Carotte rouge demi-longue obtuse*, VIL., '84, '85: Ger., Halblange rothe stumpfe Möhre, Vil.

Root præmorse conical, growing mostly below ground, rounding to a very small neck, which is surrounded by a distinct hollow; well developed samples 2 in. in diameter, 5 or 6 in. long; skin reddish orange, sometimes shading to dark brown about the neck; surface rather deeply striate; tap-root well defined, slender, white;—foliage scanty or medium;—flesh reddish orange, with a small or medium sized core;—season rather early.

No. 24. LUC HALF LONG, VEG. GAR.

Syn. *Half Long Luc.*, Thor., '83; Vil., '84: *Luc New Half Long*, Thor., '85: *New Half Long Luc*, Thor., '87: Fr., *Carotte demi-longue de Luc*, VIL., '84.

Resembles the Half Long Blunt Scarlet in its general character, but differs from it in the root being rather longer, thicker at the top, and more inclining to conical; well developed samples 2 in. in diameter, 6 in. long;—foliage abundant; core rather small, not very distinct; season rather early.

Correctly figured in Les pl. pot., p. 64; Veg. Gar., p. 165.

C. Root very short—the length not exceeding twice the diameter.

‡ Root orange or red.

No. 25. EARLY HORN, BRILL; BURR; WHITE; Thor., '87.

Syn. *Blunt Rooted Early Scarlet Horn*, Land., '86: Dutch Horn, Burr: Early Scarlet Dutch Horn, VEG. GAR.: *Early Scarlet Horn*, Burr; Greg., '87; HEN.; Vil.: *Early Scarlet Horn Blunt Rooted*, Ev., '85: *Early Scarlet Short Horn*, Sib., '85: Early Short Dutch, Burr: *Early Short Scarlet Horn*, Vil., '84, '85: *Early Very Short Scarlet?*, Greg., '84, '87: Fr., Carotte de

Croissy, Vil.: C. queue de souris, Vil.: C. rouge courte de Hollande, Vil.: *C. rouge courte hâtive*, VIL., '84, '85: C. vitelotte, Vil.: Ger., Feine rothe kurze stumpfe frühe holländische Möhre, Vil.: Flam., Korte vroege wortel: Holl., Vroege korte broei-wortel, Vil.: Port., Cenoura d'Hollanda vermelha, Vil.

Root short præmorse conical, about twice as long as thick, very regular; well developed samples 2 in. in diameter, 4 in. through the axis; skin orange, dark greenish or brown about the neck, which is very small, and set in a hollow; surface usually densely and deeply striate; tap-root small clearly defined; — foliage very scanty; — flesh deep orange yellow, fine grained, and of good quality; — season very early.

Grown chiefly for bunching in the green state; sometimes used for forcing, but not sufficiently productive for the general crop. On thin soils, however, it often yields as much as the longer varieties.

Correctly figured in Les pl. pot., p. 62; Veg. Gar., p. 162; Field and Gar. Veg. of Am., p. 25.

No. 26. FRENCH FORCING, Vil.

Syn. Earliest Short Forcing Horn, Burr: Early Forcing Horn, Burr: Early Frame (d), BURR: *Early French Forcing*,, HEN., '87: *Early French Scarlet Forcing*, Sib., '83: Early French Short Horn (d), WHITE: Early Red Short Horn, Vil.: Early Short Horn, Veg. Gar.: Early Short Scarlet, Burr: *Extra Early Forcing*, Thor., '87: *French Horn*, VEG. GAR.; Vil., '84: *Golden Ball?* Ev., '85: *Very Early Scarlet Forcing*, Vil., '84: Fr., Carotte á châssis, Vil.: C. carline, Vil.: C. grelot, Vil.: C. rouge très courte à châssis, VIL.: C. toupie, Vil.: Ger., Sehr kurz stumpfe früheste Treib-Möhre, Vil.: Flam., Korte ronde wortel, Vil.: Holl., Allerkorste parijsche ronde broei wortel, Vil.: Dan., Pariser drive guleroden, Vil.: Port., Cenoura redonda de Paris, Vil.

Root very short præmorse conical, growing mostly beneath the soil; well developed samples 2 in. in diameter, 2 to 3 in. through the axis; skin of a half transparent reddish orange, greenish or brown about the neck, which is very small, and surrounded by a hollow; surface rather densely, often deeply striate; tap root clearly defined, very slender, white; — foliage very scanty; — flesh red, fine-grained, mild, and well flavored.

The earliest variety, and the one most used for forcing, for which its small size and scanty foliage especially adapt it.

Correctly figured in Les pl. pot., p. 62; Veg. Gar., p. 162.

No. 27. GARTIER'S RED HORN, Ben., '83; Vil., '84.

This appeared to be a strain of the Early Horn, a little larger in size, and nearly or quite without core.

No. 28. GUERANDE, Greg., '84, '86.

Syn. Blunt-Rooted Guerande, VEG. GAR.: *Guerande Half Long Stump Rooted,* Vil., '84: *New Guerande,* Thor., '87: Fr., Carotte rouge demi-courte de Guerande, Veg. Gar.

Root very short præmorse conical, shaped much like the French Forcing, but of 2 or 3 times its dimensions; well developed samples 3½ in. in diameter, 5 or 6 in. through the axis; skin orange, often white immediately about the slender, well defined tap-root, and greenish or brown about the very small neck; surface deeply striate, often irregular; — foliage medium, or scanty; — flesh orange, not very firm, but tender and well flavored, with a rather large core, sometimes hollow in large samples; — season medium, or rather early.

Correctly figured in Veg. Gar., p. 162.

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The figures refer to the number of the variety in the described list.

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RADISH.

In this article the varieties of radish are classified with reference to the form of the root. A plan more often adopted in horticultural works is to divide the varieties into three classes with reference to the season in which the roots are usually used; viz., spring radishes, summer or autumn, and winter radishes. This method has the advantage of bringing all those varieties together which are planted at the same time, and of which the culture is the same. But as a leading object in offering these descriptions is to furnish a ready means for identifying varieties, it has seemed better to base the classification upon the form of the root, regardless of size or season. For the convenience of those who may desire to know which of the varieties are best adapted to forcing, or open air culture, and for the spring, summer, autumn or winter crop, a list of the varieties best suited to each of these classes is given at the close of the descriptions.

Synopsis of Classification.

1. Root oblate, spherical or top shaped:
    - A. Root white, Nos. 1-4 inclusive.
    - B. Root yellow, light brown or grayish, Nos. 5-8 inclusive.
    - C. Root red, Nos. 9-14 inclusive.
    - D. Root purple, Nos. 15-16.
    - E. Root black, Nos. 17-18.
2. Root more or less distinctly oval:
    - A. Root white, No. 19.
    - B. Root grayish, No. 20.
    - C. Root red, Nos. 21-27 inclusive.
    - D. Root purple, No. 28.
3. Root conical, or cylindri-conical:
    - A. Root white, Nos. 29-34 inclusive.
    - B. Root grayish, No. 35.
    - C. Root red, Nos. 36-40 inclusive.
    - D. Root purple, Nos. 41-42.
    - E. Root black, No. 43.

Description of the Varieties.

Note.—The leaves are understood to be interruptedly pinnate unless stated otherwise. See note p. 168.

1. Root oblate, spherical or top shaped.

A. Root white.

No. 1. EARLY WHITE TURNIP-ROOTED, Burr,

Syn. *Earliest Short-Topped White*?, Land., '84: Early White, Vil.: *Early White Small Turnip*, Vil., '84: *Early White Turnip*, Thor., '85: *Short Top Earliest White Turnip*?, Land., '86: Small Early White Turnip, VEG. GAR.: Fr., Radis blanc petit hâtif de Hollande, Vil.: R. rond blanc hâtif, Burr: *R. rond blanc petit hâtif*, VIL., '84: Ger., Plattrunde allerfrüheste kurzlaubigste weisse Monats-Radies, Vil.: Holl., Witte radyijis om te broeien, Vil.

Root distinctly flattened, or roundish, growing mostly below ground; white, or faintly tinged with green about the neck; well developed samples $1\frac{3}{4}$ in. in diameter in both directions; surface somewhat roughened about the rather large neck in full grown samples; tap-root very slender and clearly defined;—foliage rather scanty, spreading; leaf segments numerous, small; petioles sometimes slightly tinged with purple above;—flesh white, with more or less translucent rays, very tender; mild in our described samples, though called by Vilmorin very piquant.

Rather less early than the earlier strains of the scarlet turnip-rooted radishes, but sometimes used for forcing.

Correctly figured in Les pl. pot., p. 521; Veg. Gar., p. 487.

No. 2. GIANT STUTTGART SUMMER, Thor., 84, '85.

Syn. *Early White Giant Stuttgart*, Vil., '84: Fr., *Radis blanc géant de Stuttgart*, VIL., '84: Ger., Stuttgarter weisser Riesen-Rettig, Vil.

Root large; conical, becoming top-shaped when full grown, growing below ground; white, sometimes slightly tinged with purple near the very large neck; well developed samples 3 to 4 in. in diameter, 3 in. through the axis; surface more or less striate, the striæ rather prominent, and whiter than the rest of the surface; tap-root thick and often branched; side-roots rather numerous;—foliage very abundant, spreading, rather deep green; leaf segments numerous, often inclining to spoon form, margin sometimes almost entire; petioles often tinged purple above;—flesh white, with distinct translucent rays, somewhat tough and piquant.

The roots may be used quite young, and those remaining will continue to increase in size for many days without losing any of their good qualities.

Correctly figured in Les pl. pot., p. 529; Veg. Gar., p. 493.

No. 3. LARGE WHITE SUMMER, Vil., '85.

Syn. *Large White Summer Turnip*, VEG. GAR.; Vil., '84: Fr., *Radis blanc rond d'été*, VIL., '84, '85: Ger., Früher Weiner weisses Mai-Rettig, Vil.

Root top-shaped, sometimes inclining to roundish, growing mostly below ground; white, sometimes faintly tinged with pale green about the rather small neck; well developed samples 2 to $2\frac{1}{2}$ in. in diameter in both directions; surface slightly striate below, often roughened and scaly about the neck; tap-root rather well defined, long, thick at its junction with the root;—foliage rather abundant, spreading or half erect; leaf segments rather numerous; petioles strong, hairy, sometimes slightly purple above; — flesh white, with translucent rays, very tender, mild, or slightly piquant.

This radish is usually allowed to attain nearly its full size before being used. In season it is rather early among the summer radishes. It appears to be little grown in this country.

Correctly figured in Les pl. pot., p. 529; Veg. Gar., p. 493.

No. 4. WHITE TURNIP-ROOTED, BURR; Vil.; WHITE.

Syn. *White Turnip*, Sib. '83.; VEG. GAR.; Vil., '85; Fr., *Radis rond blanc*, VIL., '85; Ger., Platrunde sehr frühe weisse Monat-Radis, Vil.: Holl., Ronde white radijs, Vil.; Port., Rabao redondo blanco, Vil.

Root less flattened, and more inclined to top-shape than that of Early White Turnip-Rooted. The foliage is also more abundant, and grows more erect and the tap-root, instead of being very slender and clearly defined, is thick and expanded at its junction with the root. The surface is often irregular, and striate about the tap-root. The plant is slower in development, and the root does not become hollow so soon; — flesh white, with translucent rays, moderately tender, mild in our described samples, but called very piquant by Vilmorin. In season it is but little later than the Early White Turnip.

B. Root yellow, light brown or grayish.

No. 5. EARLY YELLOW, Vil.

Syn. *Early Yellow Turnip*, Sib., '83: Small Early Yellow Turnip-Rooted, BURR: Fr., Radis ronde hâtif de tous les mois, VIL.: Ger., Runde gelber Weiner Trieb-Radies, Vil.: Holl., Ronde gele radijs, Vil.: Port., Rabao redondo amarello, Vil.

Resembles the Yellow Summer Turnip, but is smaller in size, much earlier, and with less abundant, distinctly lyrate foliage; skin rather smooth, dull yellow; flesh fine-grained, rather piquant.

This variety is being largely superseded by the Golden Globe.

No. 6. GOLDEN GLOBE, H. & W., '85; Land., '84, '85; Sib., '83.

Syn. *Golden Yellow Turnip*, VEG. GAR.; Vil., '84: *Golden Summer Turnip*, Thor., '85: Fr., *Radis rond jaune d'or*, VIL., '84.

A strain of the Early Yellow, considerably earlier in maturity, with a more regular, more spherical, smoother, smaller necked root, of a brighter and clearer yellow color. The surface is very finely reticulated with whitish cracks when the root is full grown; — foliage distinctly lyrate, the terminal segment very large, oval, margin sometimes nearly entire; — flesh white, with distinct translucent rays, very tender and mild. The finest early yellow radish.

Root and leaves correctly figured in Les pl. pot., p. 522; Veg. Gar., p. 487. The cut called "Yellow Summer Turnip" in Gar. for Profit (ed. 1887), p. 277, is really the Golden Globe.

No. 7. GRAY ROUND SUMMER, Vil., '84, '85.

Syn. Gray Summer, Burr: *Gray Summer Turnip*, HEN.; Thor., '84, '85; VEG. GAR: Gray Turnip-Rooted, BURR: Round Brown, Burr: Fr., *Radis gris d'été rond*, VIL., '84, '85.

Root variable, but usually roundish, or slightly top-shaped; closely resembles the Yellow Summer, with the exception of its color, which is a dull yellow or dirty white, often faintly tinged with pale green about the neck; like the Yellow Summer, the root grows very large, but should be used when about half grown. The season and qualities of the two are the same.

No. 8. YELLOW SUMMER, Brill; White.

Syn. *Oval Yellow May*, H. & S., '86: *Yellow Summer Turnip*, HEN.; Thor., '84, '85; VEG. GAR.: Yellow Turnip, Vil.; Yellow Turnip-Rooted, Burr: Fr., Radis de Russie, Vil.: R. jaune ou roux d'été, VIL.; Ger., Früher gelber Weiner Mai-Rettig, Vil.

Root globular, sometimes slightly oblong, and sometimes inclining to top-shaped, growing chiefly below the ground; deep yellow, inclining to grayish; surface finely reticulated with white cracks; full grown roots sometimes attain 4 in. in diameter, but they usually become pithy before attaining half this size; surface somewhat scaly about the rather large neck; tap-root well defined, rather thick; — foliage abundant, spreading; petioles little hairy, sometimes tinged purple above; — flesh white, with distinct translucent rays, tender, rather piquant.

"With the exception of the Black Spanish radish, perhaps no other variety has so strong a flavor." Vil.

Figured correctly in Les pl. pot., p. 530; Veg. Gar., p. 494.

C. Root red.

No. 9. EARLY SCARLET ERFURT, Land., 85.

Syn. *Earliest Scarlet Erfurt*, Land., '84: *Earliest Scarlet Erfurt Turnip*, Ben., '86: *Early Scarlet Prussian Globe*, Land., '84: *Erfurt Short-Top Scarlet*, H. & S., '86: *Erfurt Scarlet Short-Top Rose*, H. & S., '86: *Extra Early Roman Carmine*, Thor., '85: Fr., rond écarlate d'Erfurt très hâtif, Ben, '86: Ger., Erfurter Dreien runde scharlachrothe kurzlaubigste, Treib, Ben., '86.

This appeared to be a very early strain of the Scarlet Turnip-Rooted, differing from it very little in other respects. It appears closely allied to the *Radis rond êcarlate hâtif* of Les pl. pot.; (Early Deep Scarlet Turnip of Veg. Gar).

No. 10. EARLY ROUND DARK RED, Hen., '84, '85.

Syn. Deep Scarlet, Vil.: *Deep Scarlet Turnip*, Thor., '84: *Early Deep Scarlet Turnip*, VEG GAR.; Vil., '84: *Garnet Turnip?*, Land., '84, '85: *Round Rose Red?*, Dam., '86: Fr., *Radis rond écarlate*, VIL., '84: Ger., Runde scharlachrothe Monats-Radies, Vil.

A strain of the Scarlet Turnip-Rooted, closely resembling the Early Scarlet Erfurt. As grown at the Station the two scarcely differed in color, but in this strain the plant was a little slower in development, and did not become hollow so soon; the flesh was often a little streaked with red, and the petioles were more colored than in the Early Scarlet Erfurt. It is described as being much deeper in color than the Scarlet Turnip-Rooted, but was not strikingly so at the Station. It is an excellent forcing radish.

Correctly figured in Gar. for Profit (ed. 1887), p. 277, Les pl. pot., p. 521; Veg. Gar., p. 436.

No. 11. EARLY SCARLET TURNIP-ROOTED, Burr.

Syn. *Early Scarlet or Red Turnip*, Sib., '83: *Early Scarlet Turnip*, HEN.; Thor., '85; VEG. GAR.; Vil., '84: Early Turnip Rooted Scarlet, Vil.: Fr., Radis rond rose hâtif, VIL., '84.

A strain of the Scarlet Turnip-Rooted, slightly more oblate, with a more slender tap-root, more scanty foliage, and several days earlier in maturing. It also becomes hollow sooner than that variety. A good forcing radish.

No. 12. GARNET TURNIP, Land., '84, '85.

This differed from the Earliest Scarlet Erfurt only in having the root very dark red, inclining to black about the neck.

No. 13. SCARLET TURNIP-ROOTED, Brill; Burr; Vil.; White.

Syn. Crimson Turnip-Rooted, Burr: Scarlet French Turnip, Veg. Gar.: *Scarlet Turnip*, Vil.,'84: Turnip-rooted scarlet French, Vil.: Fr., *Radis rond rose ou saumoné*, VIL., '84: Ger., Rosenrothe runde Monats-Radies, Vil.: Holl., Ronde rose rood radijs, Vil.: Port., Rabao redondo roso, Vil.

Root nearly spherical, somewhat top-shaped when quite small, becoming slightly oblate when full grown, growing mostly below ground; deep scarlet; about 1 in. in diameter when in best condition; surface smooth, tap-root white in the lower ⅔; — foliage very scanty, grayish green; petioles somewhat hairy, slightly tinged with red above; — flesh white or faintly tinted with rose, with translucent rays, mild and tender; — season early.

Several more or less distinct strains of this radish have appeared in later years, differing from it more or less in earliness, color and amount of foliage.

Correctly figured in Les pl. pot., p. 520; Veg. Gar., p. 485.

No. 14. WHITE TIPPED SCARLET, Hen.

Syn. *Early Scarlet Turnip (with white tail)*, Thor., '84, '85: Early White-Tipped Scarlet Turnip, Veg. Gar.: *Scarlet Turnip White-Tipped*, Vil., '84: *Sutton's Rosy Gem*, J. & S., '86: Fr., *Radis rond rose à bout blanc*, VIL., '84.

A strain of the Scarlet Turnip-rooted, differing from it in being paler in color, and in shading to white about the tap-root. The upper part of the root is a lively rose color. It is one of the earliest of all radishes, but becomes hollow very soon after attaining its size.

Correctly figured in Gar. for Profit, (ed. 1887,) p. 277; Les pl. pot., p. 520; Veg. Gar., p. 486.

D. Root purple.

No. 15. PURPLE TURNIP-ROOTED, Burr.

Syn. *Early Purple Turnip*, VEG. GAR.; Vil., '84: Early Purple-Turnip-Rooted, Vil.: *Purple Turnip*, Thor., '85: Fr., *Radis rond violet*, VIL., '84: Ger., Violet-rothe Treib-Radies, Vil.: Holl., Ronde violette radijs, Vil.: Port., Rabao redondo violeta, Vil.

Root roundish or slightly oblate, often growing somewhat above ground; clear purple, inclining to black about the neck; well developed samples 1½ in. in diameter in both directions; tap-root slender, very clearly defined, white except near its junction with the root; neck medium to small; — foliage rather abundant, very spreading, deep green; petioles little hairy, tinged with purple above; — flesh translucent, with white rays, or sometimes white, faintly tinged purple, rather piquant, and does not soon become hollow. In season it is about ten days later than the earliest radishes.

No. 16. VIOLET TURNIP WHITE-TIPPED, Hen., '87.

Very similar to the preceding, with the exception that the entire tap-root, with a portion of the skin surrounding it, is white.

E. Root black.

No. 17. BLACK SUMMER TURNIP, Hen., '87.

Syn. *Black Turnip*, Ben., '86: Early Black? (d), Burr: *Small Black Summer*, Vil., '84: Small Black Summer Turnip, VEG. GAR.: Fr., *Radis d'été* *noir rond amélioré*, Ben., '86: *R. noir rond d'été*, VIL., '84: Ger., *Runde schwarzer feinlaubiger Sommer-Rettig*, Ben., '86: Schwarzer runder S. R., Vil.

Root top-shaped, inclining to spherical, densely and finely cracked longitudinally, reminding one somewhat of the bark on young ash or hickory trees; black on the outside, the cracks dirty white; the root is also marked with a few whitish transverse lines; tap-root very long, rather thick; neck large;—foliage abundant, grayish green; leaves almost always cut to the midrib, lobes crenate, a shade darker than the very short, hairy petioles;—flesh white, with translucent rays, and a very distinct cambium line, firm but very acrid.

Of medium season, and does not become pithy as soon as many others.

No. 18. ROUND BLACK SPANISH, HEN.

Syn. *Black Round Spanish Winter*, Vil., '84: Black Spanish, Vil.: *Black Spanish Round*, Sib., '83; Thor., '85: Black Spanish Winter Turnip, VEG. GAR.: Fr., Radis de Strasbourg, Vil.: *R. noir gros rond d'hiver*, VIL., '84: Raifort cultivé, Vil.; Raifort d'hiver, Vil.: Ger., Runder grosser Mulhauser Rettig, Vil.; Runder schwarzer Winter-Rettig, Vil.: Holl., Ronde Zwarte rammenas, Vil.

Root roundish or short top-shaped, growing beneath the soil; skin rough, black, with numerous and narrow white cracks; larger specimens sometimes rather deeply cracked longitudinally; surface often striate towards the well-defined but thick tap-root, the striæ prominent and white; neck large;—foliage very abundant, clear or slightly grayish green; leaf segments numerous, extending nearly to apex, often somewhat folded on the midrib, borders undulate, surface of leaves somewhat roughened through the depression of the veins, but scarcely blistered; petioles pale green, sometimes a little tinged with red on the upper side;—flesh white, finely and distinctly rayed, rather tender, very acrid, crisp.

The samples described were about 2 in. in diameter in both directions, but the root often attains 3 in. in diameter.

It is not very late for a winter radish, and keeps well, but is one of the strongest in flavor of all varieties.

A purple strain of this radish is extant, but has not been grown at the Station.

Correctly figured in Les pl. pot., p. 531; Veg. Gar., p. 495.

2. Root more or less distinctly oval.

A. Root white.

No. 19. WHITE OLIVE-SHAPED, VEG. GAR.; Vil., '84.

Syn. Oblong White, Vil.: Fr., *Radis demi-long blanc*, VIL., '84: Ger., Ovate weisse Radies, Vil.

Root regular oval, white in the lower half, with a semi-translucent appearance, faintly tinged with green about the small neck; surface very smooth; tap-root well defined, very slender; — foliage scanty; petioles scarcely paler than the leaves, hairy, sometimes faintly tinged with purple towards the base; — flesh white, translucent, mild and tender; — in season quite early.

This radish may be used either for forcing, or the open ground. Mixed with the scarlet varieties, the roots form a pleasing contrast.

Correctly figured in Les pl. pot., p. 524; Veg. Gar., p. 490.

B. Root grayish.

No. 20. OLIVE GRAY, Sib., '83.

Syn. Gray Olive-Shaped, BURR.

A variety of the olive-shaped radish having a dark brown or grayish skin, which is finely reticulated with whitish cracks. The root grows mostly below ground; tap-root pretty well defined; neck medium; — foliage very abundant; petioles more or less tinted with purple; — flesh pure white, with translucent rays, crisp, tender, and rather piquant; — season early.

C. Root red.

No. 21. CHINESE SCARLET WINTER, VEG. GAR.

Syn. *Chinese Rose*, Sib., '83: Chinese Rose-Colored Winter, Vil.: Rose China Winter, Vil.: Rose Chinese Winter, BRILL: Rose-Colored Chinese, BURR: *Scarlet China Winter*, Vil., '84: *Scarlet Chinese Winter*, Burr; Thor., '83: *Fr.*, *Radis rose d'hiver de Chine*, VIL., '84: Ger., Chinesicher rosenrother Winter-Rettig, Vil.

A very distinct variety. Root short cylindrical, often swollen towards the lower end, very regular, rounding rather abruptly to the neck and to the tap-root; growing 1 to 2 in. above ground; scarlet or rose, mixed a little with russet about the rather large neck; well developed samples 5 in. long, 2 in. in longest diameter; surface very smooth with the exception of some conspicuous white striæ; tap-root remarkably well defined, rather thick, often with an expansion some distance below the root, white, shaded with rose; — foliage distinct, low and spreading, dull green; segments of leaves very numerous, often somewhat folded on the midrib, with irregularly crenate, or nearly entire margins, and undulate borders; petioles scarlet, somewhat glaucous, with a few whitish hairs; — flesh white, with numerous translucent rays, remarkably firm, but very crisp, rather piquant; — season very late.

Correctly figured in Les pl pot., p. 534; Veg. Gar., p. 498.

A purple and a white variety are extant which scarcely differ from the above except in color.

No. 22. EARLY DEEP SCARLET OLIVE-SHAPED, VEG. GAR; Vil., '84, '85.

Syn. Fr., *Radis demi-long écarlate hâtif*, VIL., 84: R. *demi-long écarlate hâtif (forme d'olive)*, Vil., '85.

This might be called a strain of the Olive-Shaped Scarlet, distinguished from it in being a shade deeper in color, the root more regularly oval in form, more blunt at the base, with a more clearly defined tap-root, and especially by its more scanty foliage; the larger leaves being but about 3 in number, and 4 to 6 in. long. In season it is slightly earlier, in quality about the same.

Well suited either for open or forced culture, and one of the most attractive of all the early radishes.

Correctly figured in Les pl. pot., p. 524; Veg. Gar., p 489.

No. 23. EARLY SHORT LEAF, Vil., '85.

Syn. *Half Long Deep Scarlet*, Vil., '85: Short Leaved Early Scarlet Intermediate, VEG. GAR.: *Vick's Early Scarlet Globe*? Vick, '87: *Radis demi-long écarlate très hâtif à courte feuille*, Veg. Gar., Vil., '85.

A strain of the Olive-Shaped Scarlet, somewhat smaller in size, distinguished by its remarkably scanty foliage, and its earliness. The leaves scarcely exceed 3 in. long at the time the root is fit for use, which is nearly as early as in the French Breakfast. Said to succeed best as a forced radish, or when grown in compost or leaf mold.

Correctly figured in Veg. Gar., p. 489.

No. 24. FRENCH BREAKFAST, HEN.; Thor., '85; VEG. GAR., Vil.

Syn. *French Breakfast White Tipped*, Sib., '83: *Olive Scarlet, (incorrectly)*, Sib., '83: Fr., Radis demi-long rose à bout blanc, VIL.: R. demi-long rose de Vaugirarde, Vil.

Root obovate, growing $\frac{1}{3}$ or more out of the ground; deep red except toward the tap-root, where it shades abruptly to white; well developed samples 2 in. long, 1 in. in diameter; surface very smooth; tap-root short and slender; neck very small; — foliage extremely scanty; leaves lyrate; petioles scarcely paler than the leaves, hairy, more or less tinged purple towards the base; — flesh white, with short translucent rays, sometimes faintly tinged with red, very tender, moderately piquant; — season very early, but the root very soon becomes hollow.

One of the best of all varieties for forcing, but not so well adapted for open culture as many others.

Correctly figured in Les pl. pot., p. 523; Veg. Gar., p. 488; Gar. for Profit (ed. 1887), p. 277.

No. 25. HALF LONG DEEP SCARLET, Thor., '85; Vil. '84.

Syn. Deep Scarlet Intermediate, VEG. GAR.: Fr., *Radis demi-long écarlate*, VIL., '84.

A strain of the Olive-Shaped Scarlet, differing from it in being a shade deeper in color, and in having the root more inclined to conical, the tap-root being less clearly defined. The skin is deep dull red above, scarlet in the lower half, shading to white in the tap-root, sometimes a little russet about the neck, which is very small; — flesh white, with some translucent rays, tender and mild, and does not become hollow as soon as some of the olive shaped radishes. The plant is quite hardy, and well suited for open culture.

Correctly figured in Les pl. pot., 523; Veg. Gar., p. 489.

No. 26. OLIVE-SHAPED SCARLET, BURR; HEN.; VEG. GAR.

Syn. Oblong Rose-Colored, Burr: Oval (or oblong) Rose-Colored White: *Scarlet Olive Shaped*, Vil., '84: Fr., Radis demi-long rose, VIL.: R. *demi-long rose (forme d'olive)*, Vil., '84.

Root oval, often quite irregular, sometimes cylindrical and rounding at both ends, growing somewhat above ground; deep carmine red; well developed samples about 1 in. in diameter and 2 in. through the axis; tap-root white except near its junction with the root; rootlets few and slender; neck small; — foliage scanty grayish green, petioles sometimes tinged purple above; — flesh white, with translucent rays, tender and mild, but rather soon becomes hollow; — season early.

The flesh of this variety is called "rose-colored" by Burr, Henderson and White, but it was not so at the Station, nor is it so called by Vilmorin.

Correctly figured in Les pl. pot., p. 523; Veg. Gar., p. 488.

No. 27. WOOD'S FRAME, Burr.

Syn. Early Frame Scarlet, Vil.: *London Particular Long Scarlet*, Greg., '84: *Market Gardener's Early Long Scarlet*, Land., '84: New London Particular, BURR: *Wood's Early Frame*, HEN., '85; H. & W., '85; Thor., '85; VEG. GAR.; Vil.: Fr., Radis long rose, VIL.: Rave rose hâtif à châssis, Vil.

Distinguished from the Long Scarlet by its rather shorter and brighter colored root, its more scanty foliage, and its greater earliness of about 10 days; differences which make it greatly preferred over the latter for forcing, for which purpose it is the one most generally grown.

"Of all radishes, this is the one that gives the largest product in a given time." Vil.

Correctly figured in Les pl. pot., p. 526; Veg. Gar., p. 491.

D. Root purple.

No. 28. PURPLE OLIVE-SHAPED, VEG. GAR.

Syn. *Purple Olive-Shape White-Tipped*, Vil., '84: Violet Olive-Shaped White Tipped, Vil.: Fr., *Radis demi-long violet à bout blanc*, VIL., '84: Ger., Ovale violette Radies untenweiss, Vil.

Root oval, sometimes approaching pyriform, growing slightly out of the ground, blackish purple about the neck, gradually becoming paler until it is pure white about the tap-root; — foliage scanty; petioles usually washed with purple above; — flesh white, with or without translucent rays, rather tough and piquant; — season nearly intermediate between the spring and summer radishes. It is best suited to open culture, but is sometimes used for forcing.

3. Root Conical, or Cylindri-conical.

A. Root White.

No. 29. LANDRETH'S WHITE LADY FINGER, Land., '85.

Syn. *Blunt-Pointed Demi-Long White May*, H. & S., '86: *Ferry's Perpetual Market*, Fer., '83.

This appeared to be an earlier and shorter strain of the Long White Naples, having milder and more translucent flesh. Well developed samples 5 in. long, 1 in. in diameter. It was rapid in development, and slow in becoming pithy.

Figured correctly in Landreth's catalogue of 1884.

No. 30. LONG NORMANDY, VEG. GAR.

Syn. Marsh, Veg. Gar.: *Normandy or Marais*, Vil., '84: Fr., *Rave de Marais*, VIL., '84.

Root long fusiform, growing much out of the ground; white in the lower part, purple where exposed to light; distinct from the fact that the part of the root that grows above ground curves and twists itself as the root becomes full grown. The roots grow rapidly, and when about half developed are excellent for use, but they soon become hollow; grown only in the open ground.

It is of no especial value, and appears to be little known in this country.

No. 31. LONG WHITE NAPLES, Sib., '83; Thor., '85; VEG. GAR.; Vil., '84.

Syn. Long White, Burr; Vil.: Naples, Burr: Vil.: White Italian, Burr; Vil.: White Transparent, Burr; Vil.: Fr., *Radis (ou rave) blanche à collet vert*, Vil., '84: Rave blanche, VIL.: Ger., Lange weisse Radies, Vil.: Ital., Ramolaccio bianco, Vil.

Root nearly of the form and size of the Long Scarlet, usually rather thicker; white shading to pale green about the rather large neck; surface somewhat striate, side roots rather numerous, often extending nearly to the top;—foliage very abundant and spreading; leaf segments very numerous, reaching nearly to the ground;—flesh white, with distinct rays, rather tough and piquant;—in season nearly intermediate between the spring and summer radishes. This variety is always grown in the open ground.

A strain is sometimes met with in which the upper part of the root is tinted with purple.

No. 32. WHITE CROOKED, BURR; Vil., '84.

Syn. Fr., *Rave tortillée du Mans*, Burr; VIL., '84.

Root long cylindri-conical, often irregular, growing much above ground, the part growing below ground often bent or twisted like a cork-screw; well developed samples 10 in. long, 2 in. in diameter; white except about the neck, where it is pale green; neck very large;—foliage abundant; leaves rather short; petioles same color as the leaves, hairy;—flesh white, with translucent rays, rather tough and piquant.

As the root often grows crooked below ground, it cannot be pulled easily when full grown without breaking. An autumn variety little grown in this country.

No. 33. WHITE SPANISH WINTER, Thor., '83; Vil.

Syn. Autumn White, Burr:* *California Large White Winter*, Thor., '85: *Dayton*? Fer., '83: Large White Spanish Winter, VEG. GAR.: *White Large Spanish Winter*, Vil., '84: Winter White Spanish, BURR: Fr., Radis blanc d'Augsburg, Burr: R. blanc d'automne, Vil.: R. de Desbent, Vil.: *R. gros blanc d'Augsbourg*, VIL., '84: Ger., Augsburger langer weisser Winter-Rettig, Vil.: Zuckerhatförmiger weisser Baskiren R., Vil.: Winter weisser langrunder R., Vil.

Root conical, or cylindri-conical; white, sometimes a little russet about the neck; well developed samples 8 in. long, 2½ in. in diameter;

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*Quite distinct from the Californian or Mammoth White Winter radish of the Vegetable Garden (Radis blanc de Californie, of Les plantes potagères). The two varieties are confused in American catalogues, each being sometimes sold for the other.

surface rather thickly striate, side-roots rather numerous, sometimes large; neck large, sometimes surrounded by a slight hollow; — foliage medium, spreading; leaves dark, slightly grayish green, very little blistered, segments rather numerous and narrow; petioles pale green, sometimes tinged purple above, hairy below; flesh white, with numerous translucent rays, rather tough and piquant, though less so than the Long Black Spanish.

An excellent winter radish. The growth is sufficiently rapid so that when sown early it may be used as a summer or autumn variety.

Correctly figured in Les pl. pot., p. 533; Veg. Gar., p. 497.

No. 34. WHITE STRASBURG, VEG. GAR.; Vil., '84.

Syn. *Half Long Strasburg*, Vil., '85: *Long White Autumn ?*, Dam., '86: *White Hospital*, Veg. Gar., Vil., '85: *White Strasburg Summer*, Thor., '83, '84: White Summer (d), BRILL: Fr., Radis blanc de l'hospital, Vil.: *R. demi-long blanc de Strasburg*, VIL., '84, '85: Ger., Weisser halblanger Strasburger oder Spitalgarten Rettig, Veg. Gar.

Root long top-shaped, or half long conical, growing mostly below ground; white, sometimes faintly tinged with green about the large neck; surface usually more or less striate below; — foliage very abundant, spreading; petioles scarcely paler than leaves, sometimes faintly tinged with purple above; — flesh white, with translucent rays; — tender, rather piquant.

The roots are fit for use when about $\frac{2}{3}$ grown. Those left will continue to grow for 3 or 4 weeks thereafter without losing their good quality.

Correctly figured in Les pl. pot., p. 530; Veg. Gar., p. 494.

B. Root grayish.

No. 35. LONG GRAY WINTER, Thor., '83.

Syn. *Gray Winter from Laon*, Vil., '84: Laon Gray Winter, VEG. GAR.: Fr., *Radis gris d'hiver de Laon*, VIL., '84.

A strain of the Long Black Spanish, differing from it in the color of the skin, which is brown or grayish, instead of black. The surface is finely reticulated with whitish cracks as in the Black Spanish. Root very regular cylindri-conical, often inclining to præmorse; well developed samples 6 to 8 in. long, $1\frac{1}{2}$ in. in diameter.

The season and qualities are the same as in the Black Spanish.

Correctly figured in Les pl. pot., p. 532; Veg. Gar., p. 496.

C. Root red.

No. 36. BECKERT'S CHARTIER, Hen., '86.

Syn. *Beckert's Improved Chartier*, Thor., '85: *Improved Chartier*, Thor., '86: *Mammoth Long Rose?*, Foote, '86.

Root long conical, growing about 1 in. above ground; crimson at the top, gradually shading to white toward the tap-root; well developed samples 1½ in. in diameter, 10 in. long; surface somewhat striate, the striæ white; neck small; — foliage very abundant, pale green, half erect; leaf-segments rather numerous, often a little folded on the midrib, margin irregularly crenate; — flesh white, tender, mild.

Rather early, of excellent quality, and remains in eating order longer than most other varieties. Even the largest roots do not become pithy; but remain crisp and tender throughout.

Introduced in 1885.

Correctly figured in Gar. for Profit (ed. 1887), p. 276.

No. 37. BOSTON LONG SCARLET, Greg., '85, '86.

A strain of Long Scarlet growing rather longer than the ordinary variety; full grown samples 10 in. long, ¾ to ⅞ in. in diameter.

No. 38. LONG SALMON, BURR; Thor., '85.

Syn. Long Scarlet, VEG. GAR.; Vil.: *Long Scarlet Salmon*, Burr; Vil., '84: Salmon, Vil.: Salmon-Colored, Veg. Gar.: *Fr.*, *Radis rose longue ou saumonée*, VIL., '84: Ger., Lange rosenrothe Radies, Vil.: Ital., Ramolaccio rosso, Vil.

Very closely resembles the Long Scarlet, but differs from it in having the root longer, and paler in color. Vilmorin states also as a distinguishing character that the flesh is tinted with pink or lilac, a difference which did not appear at the Station. In their qualities the two are practically identical.

Unfortunately, the name Long Scarlet, adopted for this radish in the Vegetable Garden and given as a synonym of it in Les plantes potagères must tend greatly to confuse the two varieties.

Correctly figured in Les pl. pot., p. 525: Veg. Gar., p. 590.

No. 39. LONG SCARLET, BRILL; BURR (credited to Thompson, not of Vil. or VEG. GAR.).

Syn. *Carter's Selected Long Scarlet*, Greg., '84: *Covent Garden*, Greg., '86: Early Frame, Burr: *Early Long Scarlet*, Sib., '83: *Early Long Scarlet Short Top*, Sib., '83: Early Scarlet Short Top, Burr; WHITE; *Long Scarlet Short Top*, HEN., '85; Thor., '85; VEG. GAR.: *Short Top Long Scarlet*, Land., '86: Fr., Rave rose à collet rond, VIL.

Root long conical, or long fusiform, 1 to 3 in. above ground, in which part the root is often crooked; dark dull red above ground, bright scarlet below; tap-root and side-roots white, the former marked with narrow transverse red stripes, and the latter rather numerous, disposed in opposite longitudinal furrows; surface considerably striate, the striæ often white; foliage very abundant, spreading; leaves occasionally lyrate; petioles somewhat hairy, more or less tinged purple above; — flesh translucent, distinctly rayed with white, very tender, mild, and does not soon become pithy; — season very early.

The samples described were 4 to 8 in. long, $\frac{5}{8}$ to 1 in. in diameter.

Several different strains of this variety are extant, most of which resemble the above in all important respects. It is one of the varieties most generally grown in this country as an early open ground radish.

The seeds of Long Salmon and Wood's Frame are probably often sold for this variety, at least such appeared to be the case in the samples received at the Station.

Correctly figured in Gar. for Profit (ed. 1887), p. 275.

No. 40. SHEPHERD, Ev., '87.

Closely resembles Beckert's Chartier, but is claimed to be earlier, and to run to seed less promptly. In our trial the two were not grown in such a way that they could be compared.

D. Root purple.

No. 41. GOURNAY LARGE PURPLE, VEG. GAR.

Syn. *Purple Large Gournay*, Vil., '85: Fr., *Radis violet d'hiver de Gournay*, VIL., '84.

A strain of the Long Black Spanish, differing from it in little except the color of the skin, which is a very dull reddish brown or purple. It may be considered intermediate between the Long Gray Winter and Black Spanish, and seems very closely allied to, if not identical with, the Large Purple Winter (syn., Purple Spanish) of Burr.

Correctly figured in Les pl. pot., p. 532; Veg. Gar., p. 497.

No. 42. LONG PURPLE, BURR; Thor., '85; VEG. GAR.; Vil., '84.

Syn. Fr., *Rave violette*, VIL., '84: Ger., Lange violette Radis, Vil.: Ital., Ramolaccio violette, Vil.

Root the form and size of the Long Salmon, growing considerably above ground, in which part it is often crooked; blackish purple above, shading to reddish purple in the lower half, tap-root white;

surface smooth, or slightly striate below; neck very small; foliage rather scanty, leaves sometimes lyrate, petioles nearly without hairs, more or less purple above; flesh translucent, with distinct white rays, very tender, slightly piquant, rather soon becomes pithy; — season rather late.

Seldom cultivated except in the open ground. "The seed leaves, which are quite large, are used as a small salad." Burr.

E. Root black.

No. 43. LONG BLACK SPANISH, HEN.

Syn. *Black Long Spanish Winter*, Vil., '84: Black Spanish, BRILL, BURR: *Black Spanish Winter Long*, Sib., '83; Thor., '85: Black Winter, or Spanish, WHITE: *Coal Black Parisian?* Farq., '85: Long Black Spanish Winter, VEG. GAR.: Fr., *Radis noir long d'hiver*, VIL., '84: Ger., Langer schwarzer Erfurter Winter-Rettig, Vil.: Holl., Lange zwarte rammenas, Vil.

Two forms of this radish are in cultivation; in one the root is conical, and in the other it is præmorse conical, or blunt at the lower end; skin thickly striate, which makes it very rough; black except an occasional white mark; side-roots remarkably few; neck very large; — foliage abundant; petioles pale green, smooth, often tinged with purple above; — flesh white, with translucent rays, tender, but quite acrid. Samples described 8 in. long, about 1 in. in diameter, though the variety often attains considerably larger dimensions.

"One of the latest and hardiest, as well as one of the best for winter use." Burr.

The præmorse form is correctly figured in Les pl. pot., p. 532; Veg. Gar., p. 496.

A GROUPING OF THE VARIETIES WITH REFERENCE TO THEIR SEASON.

The following varieties possess qualities that make them especially adapted for forcing:

Early Deep Scarlet Olive-Shaped.
Early Round Dark Red.
Early Scarlet Erfurt.
Early Scarlet Turnip-Rooted.
Early Short Leaf.
French Breakfast.
Garnet Turnip.
White-Tipped Scarlet.
Wood's Frame.

The following are sometimes used for forcing, but are perhaps more used for spring sowing in the open ground:

Beckert's Chartier.
Boston Long Scarlet.

Early White Turnip-Rooted.
Golden Globe.
Half-Long Deep Scarlet.
Landreth's White Lady Finger.
Olive-Shaped Scarlet.
Purple Olive-Shaped.
Purple Turnip-Rooted.
Scarlet Turnip-Rooted.
White Olive-Shaped.

The following, though sufficiently early for spring radishes, are grown almost exclusively in the open ground:

Early Yellow.
Long Salmon.
Long Scarlet.
Long Purple.
Long White Naples.
White Turnip Rooted.

The following grow to a larger size than any of the above, and remain longer without becoming hollow or pithy, and are hence adapted for summer and autumn use. They do not, however, keep sufficiently well for winter use:

Black Summer Turnip.
Giant Stuttgart Summer.
Gray Round Summer.
Large White Summer.
Long Normandy.
White Crooked.
White Strasburg.
Yellow Summer.

The following are slow in development, and keep sufficiently well for winter use:

Chinese Scarlet Winter.
Gournay Large Purple.
Long Black Spanish.
Long Gray Winter.
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TURNIP.

NOTE.—In the turnip, as in the radish, the most common form of leaf, is inturruptedly, or irregularly pinnate, i. e., the leaf is pinnately divided, but the segments are irregularly disposed, and of unequal size. In a few varieties the leaves are rather distinctly lyrate, i. e. the margin deeply cut, but the incisions not reaching clear to the midrib. In other varieties the leaves are spatulate, with nearly entire margins. In the following descriptions, when the form of the leaf is not mentioned, it is understood to be interruptedly pinnate.

The following classification is adopted in this article:

1. Root distinctly conical, or cylindri-conical.
    - A. Root white, at least in the lower part, Nos. 1–7, incl., also No. 40.
    - B. Root yellow, at least in the lower part, No. 8.
    - C. Root grayish, brown, or black, at least in the lower part, Nos. 9–12, incl.
2. Root more or less distinctly oval.
    - A. Root white, at least in the lower part, Nos. 13–14.
    - B. Root yellow, at least in the part below ground, No. 36.
3. Root spherical, or top-shaped.
    - A. Root white, at least in the lower part, Nos. 15–20, incl.
    - B. Root yellow, at least in the lower part, Nos. 21–23, incl. also No. 28.

4. Root distinctly flattened.
    - A. Root white, at least below, Nos. 24–31, incl., also No. 36.
    - B. Root yellow, at least below, Nos. 32–34, incl., also Nos. 39 and 41.
    - C. Root grayish, brown, or black, No. 35.

DESCRIPTION OF THE VARIETIES.

1. Root distinctly conical, or cylindri-conical.

A. Root white, at least in the lower part.

No. 1. COW-HORN, BURR; Sib., '83; Vil., '84.

Syn. Long White Cow-Horn, BRILL: Long Early White Vertus (Incorrectly), Burr: *Long White Meaux*, Vil., '84: Fr., Navet corne de bœuf, Vil.: *N. de Meaux*, VIL., '84: N. long de Meaux, A. de Cl.: Ger., Lange Ochshorn von Meaux, A. de Cl.

Root rather long cylindri-conical, rounding very slightly to a medium sized neck, sometimes inclining to præmorse below, growing much above ground, very often more or less crooked; white below ground, pale green, cream-color or pinkish above; well developed samples 4 in. in diameter, 10 in. long; surface somewhat striate in the lower half; tap-root often rather well defined; — foliage abundant, deep green; leaves little blistered, usually petioled, segments large, much waved; — flesh white, compact, somewhat dry, rather sweet; — season late.

"As a field turnip it is one of the best, and when pulled young, good for table use. During winter, the roots often become dry and spongy." Burr. "Very valuable for stock, decidedly the best white turnip for family use in winter." Brill.

Correctly figured in Les pl. pot. p. 361; Veg. Gar., p. 581.

No. 2. FRENEUSE, Burr; VEG. GAR.; Vil., '84.

Syn. Fr., *Navet de Freneuse*, VIL., '84: Ger., Weisse von Freneuse Rübe, A. de Cl.

Root conical, growing almost entirely below ground; white except about the neck, where it shades toward green; well developed samples 1½ in. in diameter, 6 in. long; neck small; surface striate in the lower ⅔; — leaves lyrate or interruptedly pinnate; blistered, midribs greenish white; — flesh white, distinctly rayed, very firm, dry; — season late.

"The most esteemed of the dry-fleshed turnips." Vil.

Correctly figured in Les pl. por., 359; Veg. Gar., p. 580.

No. 3 GREEN TANKARD, BURR; VEG. GAR.

Syn. *Long Green Tankard,* Vil., '84: *Long White Tankard,* Thor., '82; Vil., '84: White Tankard (d), BURR; Vil.: Fr., Navet de campagne, Vil.: N. de Vovincourt, Vil.; N. gros d' Alsace, Burr: N. gros de Berlin, Vil.: *N. gros long d'Alsace,* VIL., '84: N. long blanc d'automne à collet vert, Vil.: Ger., Grünköpfige Ulmer Rübe, Vil.: Lange grünköpfige Herbst-Rübe, A d Cl.: Langeweisse grünköpfige R., Vil.

Root cylindri-conical, growing 1 to 4 in. above ground; white below ground, very pale green, slightly scaly above; well developed samples $2\frac{1}{2}$ in. in diameter, 10 in. long; surface striate below ground, obscurely so above; neck large; — foliage medium, deep green, leaves sometimes lyrate, segments numerous, little blistered, borders undulate; — flesh white, tender, rather watery; — season rather late.

Chiefly cultivated for forage, but when young, good for table use.

Correctly figured in Les pl. pot., p. 361; Veg. Gar., p. 581.

No. 4. LONG WHITE CLAIRFONTAINE, Burr; VEG. GAR., Vil., '84.

Syn. Long White Maltese, BURR: Fr., *Navet de Clairfontaine,* VIL., '84.

Root cylindri-conical or conical, often irregular, usually growing somewhat above ground; whitish below ground, greenish or purplish about the neck; well developed samples $1\frac{1}{2}$ in. in diameter, 6 in. long; surface striate in the lower $\frac{3}{4}$; tap-root often branched; — foliage very abundant, deep glossy green, leaf-segments large, waved; — flesh white, distinctly rayed, tender; — season rather early.

No. 5. LONG WHITE STRAP-LEAF, Thor., '83.

Syn. *Cow Horn Strap-Leaf.,* Thor., '83.

Root conical or cylindri-conical, often growing considerable above ground; resembles that of Cow Horn rather closely except that it is less often crooked, and is considerably smaller in size, well developed samples 7 or 8 in. long and $1\frac{1}{2}$ to 2 in. in diameter; — leaves spatulate, spreading, slightly glossy, blistered, margin shallow erose dentate, rather deeply cut towards the base, border undulate; — flesh white, rayed, firm.

No "strap-leaved" long turnip is mentioned in Les plantes potagères.

No. 6. RED TANKARD, BURR; Vil.

Syn. *Long Red Tankard,* VEG. GAR.; Vil., '84: Fr., Navet d' Ulm., Vil.: N. long à collet rose de Verdun, Vil.: N. long rouge d' Automne, Vil.; *N. rose du Palatinat,* VIL., '84: Rave Rose longue de Brest, Vil.: Ger., Lange rothköpfige Herbst-Rübe, A. de Cl.: Lange weisse rothköpfige Rübe, Vil.: Rothköpfige Bamberger R., Vil.

Root cylindri-conical, growing 2 to 3 in. above ground; white below ground, dull purplish red, mingled with russet above; well developed samples 2½ in. in diameter, 10 to 12 in. through the axis; surface striate below ground, obscurely so above; side-roots very few; tap-root often branched; neck rather large; — foliage very abundant, slightly glossy; leaf segments much waved, deeply dentate or crenate, borders much undulate, sometimes almost ruffled, midribs greenish white; — flesh white, distinctly rayed, tender; — season late.

Correctly figured in Les pl. pot., p. 361; Veg. Gar., p. 582.

"Diffused and esteemed throughout Europe, from Poland to England." Vil.

No. 7. SEVEN-TOP, HEN.; Sib., '83.

A poorly developed variety extensively cultivated in the South for the foliage, which is used for greens.

Foliage medium or abundant, very spreading; leaves interruptedly pinnate, blistered, midribs sometimes much tinged with purple; root short or long conical, irregular, striate; tap-root much branched; side roots numerous; neck large.

Said to be sufficiently hardy to endure the winter in the Southern States.

See also No. 40, Southern Prize.

B. Root yellow, at least in the lower part.

No. 8. LONG YELLOW, VEG. GAR.; Vil.

Syn. *Ottersberg*, H. & S., '86: Small Long Yellow (d), BURR: Fr., Navet jaune long, VIL.: Ger., Gelbe lange Rübe, A. de Cl.: Gelbe lange Ottersberger R., Vil.

Root conical or cylindri-conical, growing mostly below ground; pale yellow throughout or slightly greenish about the neck; well developed samples 1¾ in. in diameter, 8 in. long; surface very smooth and regular, finely striate; neck small; — foliage medium, very deep green, slightly glossy; leaf-segments numerous, finely toothed or entire, blistered; — flesh yellow, fine, sweet and well flavored; — season rather late.

The root keeps well; recommended only for table use.

Correctly figured in Les pl. pot., p. 362; Veg. Gar., p. 582.

C. Root grayish, brown or black, at least in the lower part.

No. 9. GRAY LUC, Veg. Gar.; Vil., '84.

Syn. *Navet gris de Luc*, VIL., '86.

Root short conical, growing below ground; dirty white, shading in some specimens to green about the small neck; well developed samples 2 in. in diameter, 6 in. long; surface somewhat striate;—foliage medium, very dark green; leaf-segments numerous, margin little toothed, midribs greenish white;—flesh white, distinctly rayed, firm, dry, resembling that of the Freneuse.

No. 10. MORIGNY GRAY, Veg. Gar.

Syn. *Gray Morigny*, Vil., '84: *Gray Stone*,? Thor., '82: Fr., *Navet gris de Morigny*, VIL., '85: Ger., Graue Morigny Rübe, A de Cl.

Root short conical, rounding gradually to the large neck, sometimes inclining to oval; skin greenish yellow about the neck, dark brown with irregular stripes of dirty white in the rest of the root; well developed samples 3 in. in diameter, 6 in. long; surface thickly striate except about the neck, where it is slightly scaly;—foliage abundant, rather spreading; midribs greenish white, sometimes tinged purple toward the base;—flesh white, distinctly rayed, very firm and crisp.

"Rather early, and a good table variety." Vil.

Correctly figured in Les pl. pot., p. 363; Veg. Gar., p. 583.

No. 11. LONG BLACK, Burr; Veg. Gar.

Syn. *Black Long*, Vil., '84: Fr., Navet noir d'Alsace, Vil.: *N. noir long*, VIL., '84: Ger., Lange schwarze Rübe, A. de Cl.: Schwarze lange mittlefrühe R., Vil.

Root long conical, rounding rather gradually to a very small neck, growing almost entirely below ground; skin dirty white in the lower half, dark brown, approaching black above; well developed samples 1¾ in. in diameter, 9 in. long; surface densely striate, somewhat scaly;—foliage medium, deep shining green; leaves finely blistered, borders often nearly entire; petioles nearly or quite clean towards the base;—flesh white, distinctly rayed, very firm.

Correctly figured in Les pl. pot., p. 363; Veg. Gar., p. 583.

No. 12. TELTOW, Burr; Veg. Gar.; Vil.

Syn. *German Teltow*, Thor., '83: *Small Berlin or Teltow*, Vil., '84: Teltau, Burr: Fr., Navet de Belle-Isle, Vil.: N. de Teltau, Vil.: *N. petit de Berlin*, VIL., '84: Ger., Kleine Mark'sche Rübe, Vil.: Markische R., Vil.: Teltauer R., Vil.: Kleine weisse Teltauer R., A. de Cl.

Root conical, not very regular, growing entirely below ground; grayish white; well developed samples 2½ to 3 in. long, 1½ in. in longest diameter; — foliage very scanty; leaves yellowish green with rounded lobes, erect when the plant is young, but falling to the ground and dying when full grown; — flesh dull white, very dry; — season early.

"The root when cooked has a peculiar flavor, completely differing from that of all other turnips. It is milder and more sugary, and the flesh is almost floury instead of being juicy and melting. The roots will keep all through the winter, and far into the following year if taken up and stored in half dry sand." Veg. Gar.

"The peculiar flavor is in the outer rind, and when used, it should not be peeled." Burr.

Correctly figured in Les pl. pot., p. 360; Veg. Gar., p. 580.

2. Root more or less distinctly oval.

A. Root white, at least in the lower part.

No. 13. JERSEY NAVET, Sib., '83; Thor., '83; Vil.

Syn. *Extra Early French?* Greg., '84: Long Early Vertus (Stump), A. de Cl.: *Long Early White Vertus or Jersey,* Vil., '84: Snow White (d), HEN.: *Snow White Olive-Shaped,* Hen., '83: Fr., *Navet long des Vertus Marteau,* VIL., '84: Ger., Frühe lange stumpfe Vertus Rübe, Vil.: Holl., Lange witte Fransche raap, Vil.

Root oblong, oval or cylindrical, swollen toward the lower end, growing about half above ground; white; well developed samples 2 to 3 in. in longest diameter, 5 or 6 in. through the axis; neck small or medium; tap-root well defined; surface somewhat striate; — foliage abundant, slightly glossy; leaf-segments numerous, usually rather small, sometimes spoon-form, midribs nearly white; — flesh white, tender, sweet, and remarkably mild; — season very early.

One of the best varieties for garden culture, either in the open ground or for forcing. The roots should be pulled when about ⅔ grown, as they are liable to become hollow if permitted to attain full size.

Correctly figured in Les pl. pot., p. 359; Veg. Gar., p. 579.

No. 14. WHITE EGG, Greg., '86; HEN.; Sib., '83; VEG. GAR.; VIL.

Root rather long top-shaped, regular, growing about half out of the ground; white; well developed samples 3 in. in diameter, 5 in. through the axis; surface more or less striate; tap-root large and branching; neck large; — foliage very abundant, somewhat glossy;

leaves blistered, midribs nearly white; — flesh white, sweet, mild and of good flavor; — season rather early.

It does not keep well during winter, but is recommended for fall marketing.

Figured correctly in Gar. for Profit (ed. 1887), p. 305.

B. Root yellow, at least in the lower part.

See Dale's Hybrid, No. 36.

3. Root spherical or top-shaped.

A. Root white, at least in the lower part.

No. 15. CROISSY, VEG. GAR.

Syn. *Croissy Oval-Shaped Second Early White*, H. & S., '86: Des Vertus, Veg. Gar.: *Round Early White Vertus*, Vil., '84: Fr., *Navet des Vertus rond ou de Croissy*, Vil., '84: N. rond de Croissy, Vil.: N. rond des Vertus, VIL.: Ger., Weisse runde von Croisse Rübe, A. de Cl.

Root top-shaped or roundish, growing mostly below ground; white throughout, or tinted with pale green about the neck; well developed samples 3 to 3½ in. in diameter, 2½ in. through the axis; surface smooth, or striate toward the tap-root, which is rather clearly defined; neck medium; — foliage abundant, deep green, slightly glossy; — leaf segments large, numerous, inner leaves finely blistered, outer ones coarsely blistered or nearly smooth, midribs greenish white, sometimes clean towards the base; — flesh white, tender, sweet and well flavored; — season early.

One of the best varieties for forcing.

Correctly figured in Les pl. pot., p. 363; Veg. Gar., p. 583.

No. 16. GREEN GLOBE, BURR; Thor., '83.

Syn. *Green Barrel*, Thor., '83: Green-Top White Globe, Burr.

Root globular or slightly oblong, sometimes inclining to top-shaped, very regular, growing about half above ground; white in the lower half, pale green above; well developed samples 5 in. in diameter, 4 in. through the axis; surface very smooth; tap-root usually well defined; neck small to medium; — foliage abundant, half erect; leaves blistered, glossy, segments waved, border undulate, margin distinctly dentate, midribs nearly white; — flesh white, firm; — season early.

A very productive variety, but it does not keep well.

No. 17. GREEN-TOP NORFOLK, Veg. Gar.; Vil.

Syn. Green Norfolk, BURR: Green Round, Burr: *Large Green Globe*, Vil., '84: Fr., *Navet de Norfolk à collet vert*, Vil., '84.

Differs little from the White Norfolk except that the upper part of the root is pale green instead of white. It is said to be rather more regular in form and hardier than the white variety.

No. 18. SNOWBALL, Burr; Hen.

Syn. *Carter's Stone or Stubble*, Greg., '83: *Early Snowball*, Hen., '86: *Early White Six Weeks or Snow*, Sib., '83: *Early White Stone*, Fer., '85: French Snowball, VEG. GAR.: *Nimble Six Weeks*, Greg., '83: Silverball, H. and S., '86: *White Garden Stone*, Sib., '83: *White Gem*, Hen., '86: Six Weeks (d), BURR, with syn. Autumn Stubble and Early Dwarf: White Stone (d), BURR, with syn. Early Stone and White Garden Stone: Fr., Navet boule de neige, VIL.

Root oblate or spherical, sometimes inclining to top-shape and often irregular, growing about half above ground; white throughout; well developed samples 4 in. in diameter, 3 to 4 in. through the axis; surface smooth; tap-root usually well defined; neck medium or large; — foliage very abundant; leaves slightly glossy, smooth or finely blistered, midribs whitish green; — flesh white, tender and of excellent flavor.

This variety is very early, but a very poor keeper. It is useful for sowing very late where earlier sowings have failed, or when ground could not be prepared early, and may be used for either garden or field culture.

Thorburn's Improved Snowball appeared to be a strain of the above, rather earlier and purer white about the neck.

No. 19. STRAP-LEAVED WHITE GLOBE, Veg. Gar.

Syn. *Landreth's Southern Snow-White Globe*, Land., '86: *Large White Globe Strap-Leaf*, Vil., '84: White Globe Strap-Leaf, A. de Cl.: Fr., *Navet blanc globe à feuille entire*, VIL., '84: Ger., Frühe kugelrunde Amerikanische Rübe, A. de Cl.

Root turbinate or spherical, growing largely below ground; white throughout; well developed samples 4 to 5 in. in diameter in both directions; surface somewhat striate in the lower half; tap-root well defined; neck medium or small; — foliage abundant, rather light, clear green; leaves oblong spatulate, with irregularly toothed margins and undulate borders, surface slightly blistered, midribs greenish white; — flesh very white, tender and mild; — season rather early.

Recommended for field culture.

Correctly figured in Album de Clichés, Vil., No. 48,433.

No. 20. WHITE NORFOLK, BURR; VEG. GAR.; WHITE.

Syn. Cornish White, Vil.: Improved White Pomeranian, Vil.: *Large White Globe*, Vil., '84: *Pomeranian White Globe*, Sib., '83; Thor., '84: *White Flat Norfolk*, Sib., '83: *White Flat or Globe ?*, Thor., '83, '86: White Pomeranian, Vil.: White Round, Burr: Fr., Navet de Norfolk, A. de Cl.: *N. de Norfolk blanc*, VIL., '84: N. globe de Pomeranian, Vil.: Ger., Späte von Norfolk Rübe, A. de Cl.

Root spherical or top-shaped, sometimes somewhat flattened and occasionally hollowed about the neck; white; well developed samples 5 in. in diameter, 4½ in. through the axis, sometimes attaining much larger dimensions; surface more or less striate about the tap-root; neck and tap-root large; — foliage very abundant; midribs greenish white; — flesh white, rather coarse-grained, sweet; — season late.

Largely grown for stock.

Correctly figured in Les pl. pot., p. 365; Veg. Gar., p. 585.

Burr describes a Pomeranian Globe, and a White Norfolk as though he considered them distinct, and Morton, in his Cyclopedia of Agriculture describes a Pomeranian White Globe, and a White Norfolk.

B. Root yellow, at least in the lower part.

No. 21. AMBER GLOBE, HEN., '86; VEG. GAR.; VIL.

Syn. *Large Amber Globe*, Fer., '83.

Root varying from distinctly oblate to roundish or top-shaped, growing about half above the ground; light yellow below, pale yellowish green in the upper third; well developed samples 3 to 4 in. in diameter, 2 to 3 in. through the axis; surface very smooth, without rootlets; tap-root well defined, sometimes quite thick; neck large;—foliage very abundant; midribs whitish green;—flesh pale yellow, sweet and mild.

A good variety either for garden or field culture; said to be very popular in the South.

No. 22. GREEN-TOP YELLOW ABERDEEN, BURR; Thor., '85.

Syn. Aberdeen, VEG. GAR.: Aberdeen Yellow, Vil.: Early Yellow Field, Vil.: Green Top Yellow?, Burr, '86: Green-top Yellow Bullock, Burr: Yellow Aberdeen Bullock, Morton: Fr., Navet jaune d'Aberdeen à collet vert, VIL.

Scarcely differs in its external characters from the Purple Top Yellow Aberdeen, except in the color of the upper part of the root which is pale green instead of reddish purple. It also grows rather deeper in the ground.

Much esteemed as a field turnip in England. According to Morton it is found less productive than the Purple Top variety, but more hardy to endure frost and less liable to mildew in autumn. [Cyclopedia of Agriculture, Article Turnip.]

No. 23. PURPLE TOP YELLOW ABERDEEN, BURR; Thor., '85.

Syn. Berwickshire, MORTON: Border Imperial, Vil., (described as a separate variety by Burr): Eclipse Purple Top, Vil.: Golden Rose? D. of A., '87: Purple-top Aberdeen, Burr: Purple-top Yellow Bullock, Burr: Tweeddale's Improved, Vil.: *Yellow Scotch or Aberdeen*, Sib., '83: Fr., Navet d'Aberdeen à collet Rouge, VIL.

Root roundish or slightly flattened, sometimes top-shaped, growing about ⅓ above ground; deep yellow below, reddish purple above; well developed samples 5 in. in diameter, 4 in. through the axis; tap-root small; neck rather large;—foliage very abundant, rather spreading; leaves often much blistered and segments much waved, midribs greenish white;—flesh cream-color, shading in samples to nearly white, sometimes finely marbled with white, tender, sweet, and approaching the ruta-bagas in solidity.

"Very hardy, and though generally grown for farm purposes is really superior to many sorts grown for table use exclusively." Burr.

With the Green-Top Yellow Aberdeen, much grown in England for agricultural purposes. Both have been considered by some as hybrids between the turnip and ruta-baga, but M. Vilmorin considers the view poorly founded.

See also No 38, Golden Ball.

4. Root distinctly flattened.

A. Root white, at least below.

No. 24. EARLY DUTCH, VEG. GAR.; Vil.

Syn. Early Flat Dutch, BURR: *Early Stone or Stubble*, Vil., '84: Early White Dutch, Burr: Early White Naples ?, Dam., '86: White Dutch, Burr; Vil.: *White Flat Dutch*, D. of A., '86: Fr., Navet blanc de Hollande, Vil.: N. cœur de bœuf, Vil.: *N. turnep*, VIL., '84: Grosse rave, Vil.: Rabioule, Vil.: Ribouille, Vil.: Ger., Weisse frühe platte Holländische Rübe, Vil.: Holl., Witte Meirapen, Vil.

Root oblate, or top-shaped, growing much below ground; white in the lower part, tinted with green where exposed to light; well developed samples 4½ in. in diameter, 3 to 3½ in. through the axis; surface smooth; tap-root usually well defined; neck medium;—foliage abundant, erect; leaves not much cut;—flesh white, tender and sweet, but lacking in solidity;—season early.

Usually grown for stock, but when young good for table use; not a good keeper.

Correctly figured in Les pl. pot., p. 364; Veg. Gar., p. 583.

No. 25. EARLY FLAT WHITE, Vil.

Syn. Early White, VEG. GAR.: *Early White Flat Dutch Garden*, Vil., '84: Fr., *Navet blanc plat hâtif*, VIL., '84: N. plat hâtif, A. de Cl.: Ger., Weisse frühe platte Rübe, Vil.: Holl., Witte vroege Meirapen, Vil. Probably the White-Top Flat of Burr.

Root very much flattened, the contour often irregular, growing mostly above ground; white throughout; well developed samples 4 in. in diameter and about 2 in. through the axis; neck and tap-root small; — foliage abundant, half erect; leaf-segments numerous, waved, sometimes growing out from the top of the nearly white midrib; — flesh white, tender, not very sweet; — season very early.

Recommended for forced culture as well as for late sowing in the open ground.

Correctly figured in Les pl. pot., p. 367; Veg. Gar., p. 586.

No. 26. JERSEY LILY, Thor., '83.

Resembles in general character the Early Flat White, and may be identical with it; root sometimes slightly hollowed about the neck; skin somewhat striate below. In other respects the resemblance is very close.

No. 27. MILAN STRAP-LEAF, Greg., '86.

Syn. Extra Early Milan (d), HEN.: *Milan Purple-Top Strap-Leaved*, VEG. GAR.; Vil., '84: Fr., Navet de Milan plat très hâtif, A. de Cl.: N. rouge de Milan à châssis, VIL.: *N. rouge de Milan plat très hâtif*, A. de Cl.; Vil., '84: N. rouge très hâtif de Milan à châssis, Veg. Gar.: Ger., Sehr frühe von Mailand Rübe, A. de Cl.

Root very strongly flattened, growing mostly above ground; white in the lower half, reddish purple about the very small neck; well developed samples 3½ in. in diameter, 1¾ in. through the axis; surface very smooth; tap-root small, clearly defined; — foliage very scanty; leaves long narrow spatulate, slightly cut towards the base, margin irregularly crenate, midribs greenish white; — flesh white, sweet and crisp.

With the exception of the Purple Top Munich this is probably the earliest variety grown.

Correctly figured in Veg. Gar., p. 578.

No. 28. PURPLE-TOP FLAT, BURR.

Syn. *Earliest Bloomsdale Red Top*, Land., '86: Early Flat Red-Top, Vil.: Early Flat Red Top Garden, VEG. GAR.: *Early Red Top Flat Garden*, Vil., '84: Large Round Naples with Red Top ?, Dam., '86: Red Top Flat' Burr: Fr., *Navet rouge plat hâtive*, VIL., '84: Ger., Frühe platte rothköpfige Rübe, Vil.

Root strongly flattened, growing much above ground; white below, dull purplish red in the upper half; well developed samples 4 in. in diameter, 2 in. through the axis; surface smooth; tap-root clearly defined; neck small; — foliage medium; leaves much cut, midribs nearly white; flesh white, close grained while young, sweet but sometimes bitter; — season very early. The root keeps very poorly.

An old and once very popular variety, now largely superseded by more desirable sorts.

No. 29. PURPLE-TOP MUNICH, Sib., '83.

Syn. *Early Purple-Top Munich*, Vil., '84: *Munich Forcing*, Dam., '86: Fr., Navet de Munich, A. de Cl.: N. plat de Mai, A. de Cl.: *N. rouge plat de Mai de Munich*, VIL., '84: Ger., Münchener Treib-Rübe, Vil.

The root resembles that of the Purple-Top Strap-leaved in form and dimensions, but is more deeply colored in the upper part. It is very much flattened, growing almost entirely above ground, often somewhat irregular in form, frequently hollowed about the neck and sometimes about the tap-root; deep purplish red in the upper ⅔, white about the tap-root, sometimes beautifully blotched with red and white about the center; neck and tap-root small; skin rough about the former; — foliage abundant or medium, leaves narrow and much cut, midribs sometimes tinged with purple; — flesh white, sweet and mild while young, becoming bitter when the root is full grown.

"Unquestionably the earliest of all turnips, furnishing roots sufficiently large for use twelve to fifteen days earlier than the Early Flat White." Vil.

Correctly figured in Les pl. pot., p. 368; Veg. Gar., p. 587.

No. 30. PURPLE-TOP STRAP-LEAVED, BURR; D. of A., '85, '86; Sib., '83.

Syn. Early Flat Red-Top Strap-Leaved, Vil.: *Early Red Strap Leaf, American Stone*, Vil., '84: Early Red Strap-Leaved American, A. de Cl.: Early Red-Top Dutch Strap-Leaved (d), WHITE: Red-Top Strap-Leaf, HEN.: Strap-Leaf Red-Top, BRILL: Red-Top Strap-Leaved American Stone, VEG. GAR.: Fr., *Navet rouge plat hâtif à feuille entire*, VIL., '84: Ger., Frühe platte rothköpfige Amerikanische Rübe, Vil.: Frühe rothköpfige Amerikanische R., A. de Cl.

Differs from the Purple-Top Flat in having entire spatulate leaves, and in being several days earlier. The root is perhaps rather more flattened, and grows rather more above ground; dimensions about the same;—foliage medium, half erect, leaves blistered, margins crenate, borders undulate; petioles winged to the base;—flesh white, sweet, mild and very well flavored;—season very early.

"Unquestionably one of the best of the flat turnips, either for garden or field. It is early, hardy, very prolific, will thrive in almost any description of soil, is of excellent quality, and rarely fails to yield a good crop. It is the best of all the flat turnips for sowing among corn or potatoes." Burr.

"A very suitable variety for frame culture. It has also the good property of forming the roots freely, even when sown in spring, and of being slower to run to seed than most other turnips." Veg. Gar.

Correctly figured in Les pl. pot., p. 368; Veg. Gar., p. 587.

No. 31. WHITE STRAP-LEAF, H. & W., '85.

Syn. Early Flat White Strap-Leaved, Vil.: Early White Dutch (Strap-Leaved), WHITE: *Early White Flat Dutch Strap-Leaved,* Fer., '83: *Early White Strap-Leaved,* Vil., '84: Strap-Leaf Early White Dutch, BRILL: White Strap-Leaved American Stone, VEG. GAR.: White-Top Strap-Leaf, BURR: Fr., *Navet blanc plat hâtif à feuille entire,* VIL., '84: N. hâtif de Mai, Vil.: Ger., Weisse frühe platte Amerikanische Rübe, Vil.

Differs from the Early Flat White in having spatulate rather than interruptedly pinnate leaves. The root is often depressed a little about the neck, and sometimes about the tap-root, and has been described as tinted green about the neck, but was not so in our tests. The contour is rather more regularly rounded than in the early Flat White. The neck is sometimes surrounded by rather prominent striæ, between which the skin is roughened;—foliage medium or rather abundant; somewhat glossy; leaves winged to the base, blistered, coarsely dentate below, crenate above, midribs greenish white;—flesh white, sweet and mild;—season very early.

"The strap-leaved turnips appear to be peculiarly adapted to the climate of the Northern States, and are generally superior in all respects to the common or white and purple top flat varieties." Burr.

Correctly figured in Les pl. pot., p. 367; Veg. Gar., p. 586.

See also No. 36. Early Red-Top Auvergne Flat.

B. Root yellow, at least below.

No. 32. MONTMAGNY, Sib., '83.

Syn. *Montmagny Yellow Purple-Top Flat,* Thor., '85; *Yellow Flat Purple Top Montmagny,* VEG. GAR.; Vil., '84: Yellow Red-Top Montmagny,

A. de Cl.: Fr., *Navet jaune de Montmagny*, VIL.,'84: Ger., Gelbe rothköpfige Montmagne Rübe, A. de Cl.

Root somewhat flattened, often approaching top-shaped, growing about half above ground; pale yellow below, shading to reddish purple about the neck; well developed samples 3 in. in diameter, 2 to 2½ in. through the axis; surface somewhat striate below and about the medium or large neck; tap-root thick; — foliage medium, deep green, spreading; leaves somewhat lyrate, midribs faintly tinged with purple; — flesh pale yellow, tender, of good flavor bfeore full grown; — season rather early.

A productive variety and a good keeper.

Correctly figured in Les pl. pot., p. 371; Veg. Gar., p. 589.

No. 33. YELLOW FINLAND, Burr; VEG. GAR.; Vil., '84.

Syn. Finland, BURR: Petrowskian H. & S., '86: *New Yellow Finland*, Thor., '83: Fr., Navet jaune de Finlande, VIL.: Ger., Finländische gelbe Rübe, Vil.: Gelbe Finländische Rübe, A. de Cl.

Root nearly hemispherical, distinctly concave below, growing largely above ground; yellow throughout; well developed samples 3 to 4 in. in diameter, 1½ to 2 in. through the axis; surface very smooth; tap-root very clearly defined; — foliage scanty; leaves short, approaching lyrate, midribs greenish white; — flesh yellow, tender and mild while the roots are young, but becoming strong and bitter when they are full grown; — season rather early.

Said to be a very hardy variety, and one that is less injured by worms in the roots than most other sorts.

Correctly figured in the Les pl. pot., p. 370; Veg. Gar., p. 589.

No. 34. YELLOW MALTA, BURR; Sib., '83; Thor., '85; Vil., '84.

Syn. Golden Maltese, Burr; Vil.: Maltese, Burr: Yellow or Golden Maltese, VEG. GAR.: Fr., *Navet jaune de Malte*, VIL., '84: Ger., Gelbe frühe Malta Rübe, A. de Cl.: Gelbe frühe platte Malta R., Vil.

Root very much flattened, sometimes slightly concave below; pale yellow, greenish about the small neck; well developed samples 4 in. in diameter, 2 in. through the axis; surface striate about the slender and well defined tap-root, rough about the neck; — foliage rather scanty; leaves blistered and waved, sometimes lyrate, midribs greenish white; — flesh yellow, distinctly rayed, firm, but often rather strongly flavored; — season rather early.

Correctly figured in Les pl. pot., p. 370; Veg. Gar., p. 589.

See also No. 39, Purple-Top Yellow Strap-Leaf, and No. 41, Yellow Dutch.

C. Root black.

No. 35. BLACK STONE, Thor., '83, '86.

Syn. *Chirk-Castle Blackstone*, VEG. GAR.; Vil., '84, '86: Round Black (d), BURR: Fr., *Navet noir rond ou plat*, VIL., '84, '86: Ger., Schwarze plattrunde Rübe, Vil.

Root somewhat flattened when full grown, growing mostly below ground; dark brown, approaching black; well developed samples 3 to 4 in. in diameter, 2 in. through the axis; surface striate about the tap-root, rough throughout from the peculiar scaly structure of the skin, which is finely reticulated with whitish cracks; neck small; — foliage medium, extremely deep green, slightly glossy, leaves scarcely blistered, midribs greenish white; — flesh white, distinctly rayed, firm, rather dry, sweet and well flavored; — season early.

Correctly figured in Les pl. pot., p. 371; Veg Gar., p. 590.

APPENDIX TO THE TURNIP.

The descriptive notes of the following varieties of turnip were not completed until after the preceding article had been written and indexed. The descriptions are therefore inserted here in alphabetical order.

No. 36. DALE'S HYBRID, Ben., '86; BURR.

Root oblong, sometimes inclining to roundish, growing mostly below ground; yellow, greenish about the medium neck; surface very smooth; tap-root small; — foliage very vigorous, with numerous narrow leaf segments; — flesh white, with yellowish specks, tender sweet and mild.

No. 37. EARLY RED TOP AUVERGNE FLAT, Vil., '84, '86.

Syn. Red-Top Auvergne Flat, A. de Cl.: Fr., *Rave d'Auvergne tardif*, VIL., '84, '86: Ger., Rothköpfige von Auvergne Rübe, A. de Cl.

Root very short top-shaped, growing $\frac{1}{3}$ or more above ground; rich purple in the upper half, white below; well developed samples 5 in. in diameter, 3 to $3\frac{1}{2}$ in. through the axis; surface smooth and regular; tap-root well defined, thick; neck large; — foliage of the greatest vigor; leaves glossy, with very large segments, surface strongly blistered; — flesh white, rather coarse and watery.

Grown chiefly for forage.

Correctly figured in Les pl. pot., p. 369.

No. 38. GOLDEN BALL, BURR, Vil.

Syn. *Orange Jelly*, Sib., '83; Vil., '84: Robertson's Golden Stone, BURR; Vil.: *Robson's Golden Ball*, Thor., '82, '85: Yellow Globe, Burr: Fr., *Navet jaune boule d'or*, VIL., '84: Ger., Goldkugel Rübe, Vil.

Root spherical, or when full grown, very slightly oblate, growing mostly below ground; yellow throughout; well developed samples 4 in. in diameter in both directions; surface very smooth; neck medium or small; — foliage medium or rather scanty, very spreading, leaf segments deeply dentate or crenate, midribs sometimes faintly tinged with purple; — flesh yellow, tender, but rather strong flavored; — season medium.

Differs from the Yellow Dutch in being more truly spherical, and in the absence of the green about the neck.

Correctly figured in Les pl. pot., p. 366.

No. 39. PURPLE TOP YELLOW STRAP-LEAF, J. & S., '86.

Root oblate, growing $\frac{1}{3}$ above ground; purple in the upper third, pale yellow below; well developed samples 3 in. in diameter, 2 in. through the axis; tap-root well defined; neck medium to large; — foliage vigorous, leaves lyrate, with crenate segments; — flesh yellowish white, with dots and stripes of deeper yellow, tender, sweet and mild.

No. 40. SOUTHERN PRIZE, Thor., '86.

Syn. *Great Southern Prize*, D. of A., '85

Root short conical, inclining to turbinate, growing below ground; white throughout, sometimes purple about the large neck; surface striate but regular; tap-root branching; — foliage abundant, very spreading; leaves sometimes lyrate, clear green, slightly glossy, segments narrow, often twisted or folded; — flesh white, very firm.

No. 41. YELLOW DUTCH, Burr; Vil., '84; WHITE.

Syn. Early Yellow Dutch, BURR: *Golden Stone*, Greg., '83: *Wilhelmsbourg*, H. & S., '86: Yellow Stone (d), Burr; Sib., '83: Fr., *Navet jaune de Hollande*, VIL., '84: Ger., Gelbe frühe plattrunde Holländische Rübe, Vil.: Gelbe Holländische Rübe, A. de Cl.: Holl., Hollandsche gele rapen, Vil.: Platte gele herbstrapen, Vil.

Root oblate, but inclining to spherical, growing slightly above ground; plain yellow below, clear green about the small neck; well developed samples 3 to 4 in. in diameter, $2\frac{1}{2}$ to 3 in. through the axis; tap-root well defined, rather large; surface smooth in the upper half, obscurely striate below; — foliage medium, spreading, rather light green, much cut; — flesh yellow, fine grained, sweet and tender; keeps well; — season medium.

It differs from the Green Top Yellow Aberdeen in the root being smaller and the flesh finer in texture.

Correctly figured in Album de Clichés, No. 48,465.

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  jaune de Montmagny 32
  jaune long 8
  long à collet rose de Verdun 6

Navet long blanc d'Automne à collet vert 3
  long de Meaux 1
  long des Vertus Marteau 13
  long rouge d'Automne 6
  noir d'Alsace 11
  noir long 11
  noir rond ou plat 35
  petit de Berlin 12
  plat hâtif 25
  rave d'Auvergne tardif 37
  rond de Croissy 15
  rond des Vertus 15
  rose du Palatinat 6
  rouge de Milan à châssis 27
  rouge de Milan plat de Mai de Munich 29
  rouge plat hâtive 28
  rouge plat hâtif à feuille entire 30
  rouge très hâtif de Milan a châssis 27
  Turnep 24
New Yellow Finland 33
Nimble Six Weeks 18
Orange Jelly 38
Ottersberg 8
Petrowskian 33
Platte gele herbstrafen 41
Pomeranian White Globe 20
Purple Top Aberdeen 23
Purple-Top Flat 28
Purple-Top Munich 29
Purple-Top Strap-Leaved 30
Purple Top Yellow Aberdeen 23
Purple Top Yellow Bullock 23
Purple Top Yellow Strap-Leaf 39
Rabioule 24
Rave rose longue de Brest 6
Red Top Auvergne Flat 37
Ribouille 24
Rothköpfige Bamberger 6
Round Black 35
Round Early White Vertus 15
Red Tankard 6
Red Top Flat 28

Red Top Strap Leaf 30
Red Top Strap-Leaved American Stone 30
Robertson's Golden Stone 38
Robertson's Golden Ball 38
Rothköpfige von Auvergne Rübe 37
Schwarze lange mittlefrühe Rübe 11
Schwarze plattrunde Rübe 35
Sehr frühe von Mailand Rübe 27
Seven-Top 7
Silver Ball 18
Six Weeks 18
Small Berlin or Teltow 12
Small Long Yellow 8
Snowball 18
Snow White 13
Snow White Olive Shaped 13
Southern Prize 40
Späte von Norfolk Rübe 20
Strap Leaf Early White Dutch 31
Strap-Leaf Red-Top 30
Strap-Leaved White Globe 19
Teltau 12
Teltauer Rübe 12
Teltow 12
Thorburn's Improved Snowball 18
Tweeddale's Improved 23
Weisse frühe plat Rübe 25
Weissefrühe platte Amerikanische Rübe 31
Weisse frühe platte Holländische Rübe 24
Weisse runde von Croissy Rübe 15
Weisse von Freneuse Rübe 2
Wilhelmsbourg 41
Witte Meirapen 24
Witte vroege Meirapen 25
White Dutch 24
White Egg 14
White Flat or Globe 20
White Flat Dutch 24
White Flat Norfolk 20
White Garden Stone 18
White Gem 18
White Globe Strap-Leaf 19

White Norfolk	2
White Pomeranian	20
White Round	20
White Strap-Leaf	31
White Strap-Leaved American Stone	31
White Stone	18
White Tankard	3
White Top Flat	25
White Top Strap-Leaf	31
Yellow Aberdeen Bullock	22
Yellow Dutch	41
Yellow Globe	38
Yellow Finland	33
Yellow Flat Purple Top Montmagny	32
Yellow Malta	34
Yellow or Golden Maltese	34
Yellow Red Top Montmagny	32
Yellow Scotch or Aberdeen	23
Yellow Stone	41

ONION.

In this article the varieties of onion are classified with reference first to the form, and second to the color of the bulb. As the varieties are rather numerous, and as the characters vary somewhat under different methods of culture and climatic conditions, this division may prove perplexing in some cases, but no more available method has suggested itself. The Potato onion and top onion are not included in the classified list, but the descriptions of these are appended at the close.

1. Bulb distinctly oblate.
    A. Bulb white. Nos. 1-12 incl.
    B. Bulb yellow or brownish. Nos. 13-25 incl.
    C. Bulb red or reddish. Nos. 26-37 incl.

2. Bulb inclining to spherical.
    A. Bulb white. Nos. 38-40 incl.
    B. Bulb yellow or brownish. Nos. 41-43 incl.
    C. Bulb red or reddish. Nos. 44-48 incl.

3. Bulb inclining to top-shape.
    B. Bulb brownish. No. 49.
    C. Bulb reddish. No. 50.

4. Bulb oval or pear-shaped.
    - A. Bulb white. No. 51.
    - B. Bulb yellow. No. 52.
    - C. Bulb red. Nos. 53-54,

DESCRIPTION OF THE VARIETIES.

1. Bulb distinctly oblate.

A. Bulb white.

No. 1. ITALIAN TRIPOLI, VEG. GAR.

Syn. *Giant White Italian Tripoli*, Hen., '85: *Italian White Flat Mammoth*, Ben., '86: Large White Flat Italian, A. de Cl.: *Large White Flat Italian Tripoli*, Sib., '83: *Large White Italian Tripoli*, HEN., '87: *Large White Tripoli*, Thor., '87: *Mammoth Silver King?*, Till., '85: *Silver King?* Ev., '86: *White Flat Italian*, Greg., '87: Fr., Ognon blanc gros plat d' Italie, A. de Cl.: O. gros plat d'Italie, Vil.: *O. de Tripoli blanc plat Mammoth*, Ben, '86: Ger., *Tripoli weisse plat mammoth Zwiebel*, Ben., '86: Weisse grosse späte Italienische Z., A. de Cl.: It., Cipolla Agostena, Veg. Gar.

Bulb very much flattened, sometimes a little concave below; pearly white; well developed samples 3½ in. in diameter, 1¾ in. through the axis; neck medium or small; root circle rather large; bulb not very firm; keeps tolerably well; — flavor mild; — season intermediate; — foliage abundant, deep green.

This variety is said to often exceed 6 in. in diameter, but to secure such dimensions in the northern States it is necessary to set out the smaller bulbs the second season.

"It is rather difficult to secure this variety true to name, and it does not appear to be very extensively grown, even in Italy." Veg. Gar.

Correctly figured in Veg. Gar., p. 363; Gar. for Profit, p. 254.

No. 2. MAGGIAJOLA, Damman's catalogue.

Syn. Neapolitan Maggiojola White, VEG. GAR.: *Neapolitan Marzajola*, HEN., '85: *White Flat Maggiojola*, Thor., '87: Fr., Ognon blanc de Juin, VIL.: O. blanc de Mai, Veg. Gar: O. blanc de Mai-June, Vil.

Bulb very much flattened; silvery white; well developed samples 4 in. in diameter, 1¾ to 2 in. through the axis; neck rather large; foliage abundant, pale green. A very early variety, but a poor keeper; considered by M. Vilmorin as a smaller and earlier form of the Italian Tripoli.

Correctly figured in Les pl. pot., p. 379.

No. 3. NOCERA, Bliss, '83.

Syn. Early Silver Nocera, BURR: Early Small Silver Nocera, Burr: Early White Nocera, VEG. GAR.; Vil.: White Nocera, Burr: White Nocera Extra Early, A. de Cl.: Fr., Ognon blanc hâtif de Nocera, VIL.: O. blanc très hâtif de Nocera, A. de Cl.: O. de Florence, Vil.: Ger., Früheste Nocera Zwiebel, Vil.: Weisse früheste von Nocera, A. de Cl.

Bulb strongly flattened; silvery white, the inner layers marked with bright green lines; well developed samples 2 to 3 in. in diameter, $\frac{4}{5}$ to 1 in. through the axis; neck small; — foliage very scanty.

A very early variety, but the bulb does not keep well, and except by the greatest care in the selection of seed is quite liable to degenerate. "In spite of all care taken in the choice of the seed a small proportion of bulbs of clear russet or buff color is almost always found." Vil.

Correctly figured in Les pl. pot., p. 377; Veg. Gar., p. 362.

No. 4. PHILADELPHIA WHITE, Greg., '83, '87.

Resembles the White Portugal; bulb strongly flattened; white below, greenish white about the neck, where it is marked with green stripes; well developed samples 3 in. in diameter, 1½ in. through the axis; — foliage medium.

Recommended as a good variety for producing sets.

No. 5. QUEEN, Hen., '85; Thor., '84, 87.

Syn. *Large White Italian Tripoli* (incorrectly), Hen., '87: *New Queen*, Greg., '85, '87; Sib., '83, '85; VEG. GAR.; Vil.: *Very Early White Reine*, Vil., '84: *White Pearl*, Greg., '87: White Very Early Queen, A. de Cl.: Fr., *Ognon blanc très hâtif de la reine*, VIL., '84.

Bulb rather strongly flattened; silvery white; well developed samples 1½ in. in diameter, 1 in. through the axis; neck and root circle very small; outer coat very thin, at maturity loosening from the bulb, exposing a greenish coat below; — foliage very scanty.

One of the earliest of all varieties, but it is by no means productive, and is a very poor keeper. It is of Italian origin. Grown at the Station from Vilmorin's seed, the bulbs inclined to grow larger than the dimensions given in Les plantes potagères.

Correctly figured in Les pl. pot., p. 376; Veg. Gar., p. 361.

No. 6. SILVER-SKINNED, WHITE (Not the Silver-Skin of BURR).

Syn. Early Paris Silver-Skinned, VEG. GAR.: Early Silver-Skin, Burr: Early White Silver-Skinned, Vil.: *Silver-Skin or White?*, Land., '86: Very Early Paris Silverskin, A. de Cl.: *White Early Paris Silver-Skin*, Vil., '84: *White Silver-Skin*, Sib., '83; Fr., Ognon blanc hâtif de Paris, VIL.: O. blanc très hâtif de Paris, A. de Cl.: O. d'aout, Vil.: Ger., Silberweisse frühe kleine Pariser Zwiebel, Vil.: Silberweisse Pariser frühe Z., A. de Cl.

Bulb rather strongly flattened; silvery or pearly white; resembles that of the Nocera, but somewhat thicker, and clothed with more compact, and more numerous coats; well developed samples $2\frac{1}{2}$ in. in diameter, $1\frac{1}{2}$ in. through the axis; neck small; — foliage medium, rather dark.

Early, keeps moderately well, mild in flavor, much esteemed for pickling.

Correctly figured in Les pl. pot., p. 377; Veg. Gar., p. 362.

This onion is sometimes confounded in American catalogues with the White Portugal.

No. 7. WHITE PORTUGAL, BRILL; Greg., '87; HEN., '85; Sib., '83; Thor., '87; Wells, '83 (Not the White Portugal of the VEG. GAR.).

Syn. American Silverskin, Ferry's catalogue: Silver-Skin, BURR; Hen.: White Portugal of New England, Burr.

Bulb rather strongly flattened; silvery white in the outer coats, the third coat often tinted with pale green about the center and toward the small neck; well developed samples 3 in. in diameter, $1\frac{3}{4}$ in. through the axis; root circle very small, often only $\frac{1}{4}$ in. in diameter; bulb firm, rather early, very mild in flavor; — foliage abundant.

A productive variety of superior quality. Under some circumstances it appears to keep well, though generally described as a very poor keeper. The name is frequently confounded with other varieties. Vilmorin gives the White Portugal as an American synonym to the *Ognon blanc rond dur de Hollande*, (White Portugal of the VEG. GAR.), a distinct variety; and the White Portugal of BURR is the *Ognon jaune-soufre d'Espagne*, or White Spanish onion of Vil.

No. 8. WHITE VALENCIA, Vil., '84.

Syn. Early White Valence, VEG. GAR.: White Valence Silverskin, A. de Cl.: Fr., Ognon blanc hâtif de Valence, VIL.: Ger., Silberweise von Valencia Zwiebel, A. de Cl.

Bulb somewhat flattened, sloping rather than rounding to the neck; usually somewhat irregular; pearly white, the outer coat without luster; well developed samples $2\frac{1}{4}$ in. in diameter, and $1\frac{1}{4}$ in. through the axis; neck and root circle large; — foliage medium, light green; bulb moderately firm; does not keep well; — rather early.

Correctly figured in Les pl. pot., p. 378; Veg. Gar., p 362.

The remaining varieties in this division have not been grown since 1883. They may or may not be distinct.

No. 9. EL PASO, Fer., '83.

Syn. *Large Mexican*, Fer., '83.

Bulb much flattened, especially below; silvery white; samples grown at the Station 3 in. in diameter, 2 in. through the axis; neck and root circle very small; bulb firm; flavor mild;—foliage abundant. It is said that in Mexico, where this variety is a favorite, the bulbs attain a diameter of six inches and a weight of two to three pounds, and that the color varies from white to light red.

No. 10. ETNA SILVER WHITE, Sib., '83.

Bulb very flat below, tapering slightly to the neck; pure white in the lower half, often greenish above, striped about the neck with green; well developed samples 2¾ in. in diameter, 1½ in. through the axis;—foliage very scanty.

No. 11. WHITE CALABRIA, Sib., '83.

Bulb strongly flattened; pure white below, greenish white, and marked with yellow lines about the neck, which with the root circle is very small; well developed samples 2 in. in diameter, 1 in. through the axis; bulb firm;—rather early;—foliage rather scanty.

No. 12. WHITE NAPLES, Sib., '83.

Bulb slightly oblate, tapering a little to the root; white with greenish marks about the rather large neck; well-developed samples 2 in. in diameter, 1½ in. through the axis; root circle very large;—foliage abundant.

B. Bulb yellow or brownish.

No. 13. BEDFORDSHIRE CHAMPION, VEG. GAR.; VIL., '84, '85.

Bulb slightly oblate; of the color of the White Spanish; pale yellow, in some samples inclining toward green, in others toward reddish or brown; well developed samples 3 in. in diameter, 2 to 2½ in. through the axis; neck medium; root circle usually small; outer envelope dry, usually rather adhesive; bulb very firm, keeps well;—foliage very abundant.

No. 14. BROWN SPANISH, VEG. GAR.; Vil.

Syn. Brown Portugal BURR: Cambria, Burr (Not of Vil.): Oporto, Burr; Vil.: Paris Straw-Colored, BURR: Straw-Colored, Vil.: Very Large Straw-colored, A. de Cl.: *Yellow Straw-Colored*, Vil., '84, '85: Fr., Ognon blond, Vil.: *O. jaune des Vertus*, Burr; VIL., '84: O. jaune paille, Vil.: *O. jaune paille des Vertus*, Vil., '85: Ger., Gelbe plattrunde harte Zwiebel, Vil.: Strothgelbe platte Vertus Z., A. de Cl.

Bulb strongly flattened; copper yellow, some samples quite glossy, others dull; well developed samples 3 to 4 in. in diameter, 1½ to 2 in. through the axis; neck and root circle rather small; outer coat rather thick and adhesive, second coat sometimes more highly colored than the outer one; inner coats faintly tinted with yellowish green in the upper half; — foliage very abundant.

"Rather early, extremely productive, keeps perfectly well, and is most grown for field culture of any. It is largely used for winter consumption in Paris and in a large part of Europe, and is often seen hanging up in dwelling houses in long bunches formed by the interlacement of the twisted dry leaves." Vil.

Correctly figured in Les pl. pot., p. 380; Veg. Gar., p. 365.

No. 15. COMO FLAT YELLOW, VEG. GAR.

Syn. *Como Yellow Flat*, Vil., '84: Como Yellow Flat Golden Gem, A. de Cl.: Fr., Ognon jaune plat de Côme, Veg. Gar.: Ger., Gelbe platte von Como Zwiebel, A. de Cl.: It., Cipoletta di Como, Veg. Gar.

Bulb strongly flattened, of a copper or salmon-tinted yellow; well developed samples 2½ in. in diameter, 1 in. through the axis; neck small; root circle very small; outer coats very thin; bulb very firm; keeps well; — season very early; — foliage abundant.

Originated at Como, in Lombardy.

Correctly figured in Veg. Gar., p. 364.

No. 16. JAUNE DE VILLEFRANCHE, VEG. GAR.; VIL., '85.

Bulb very much flattened, sometimes concave below; yellowish, or salmon rose; well developed samples 3 in. in diameter, 1½ in. through the axis; outer coat dry, rather thick and strong, inner coats pure white, or slightly tinged green near the neck; bulb very firm; keeps well; — season very early; — foliage medium.

No. 17. NASBEY'S MAMMOTH, Greg., '85, '86, '87.

Syn. Improved Reading (d), Vil.: Nuneham Park (d), Vil.: Nasby Mammoth (d), Vil.:

Bulb somewhat flattened; pale yellow, sometimes inclining to red, usually a shade lighter below; well developed samples 3¼ in. in diameter, 2 in. through the axis; neck large; root circle about ½ in. in diameter; outer coat brittle, little adherent, inner coats slightly tinted with purple in the upper half; bulb very firm; keeps well; — foliage very abundant.

"A form of the White Spanish onion, with the bulb somewhat thicker and darker colored." Vil.

No. 18. STRASBURG, BURR; Hen., '85, '87; VEG. GAR.

Syn. Deptford, Vil.: Dutch, Burr: Essea, Vil.: Essex, Burr; Veg. Gar.: Flanders, Burr; Vil.: *Large Yellow*, Greg., '87: *Large Yellow Dutch*, Sib., '83: Strasbourg, Vil.: *Strasburg Dutch*, Vil., '84: *Yellow Dutch*, Hen., '85, '87: *Yellow Strasburg*, Burr; Greg., '87; WHITE: Fr., Ognon de Cambria, VIL.: O. de Mulhouse, Vil.: O. jaune de Laon, Vil.: O. jaune paille plat de Flandre, Vil.: O. suisse, Vil.

The Deptford, Syn. Brown Deptford of Burr is described as "Very similar to, if not identical with the Strasburg."

Bulb usually more or less flattened, though sometimes globular; brown, inclining somewhat toward red, second coat pale reddish brown, much tinged with green, inner coats white except near the neck, where they are tinted with green; well developed samples 3 in. diameter, and fully 2 in. through the axis; neck and root circle small; bulb very firm, and an excellent keeper; — medium in season; — very productive.

The bulb of this variety bears a close resemblance to the more flattened forms of the Yellow Danvers, but is usually of smaller size. It is very hardy, and is thought one of the best for winter production at the South; much used for the production of sets.

No. 19. SULPHUR YELLOW, Ben., '86.

Syn. Bambury, Vil.: Cambridge, Burr; Vil.: Portugal, Vil.: Reading, Vil.: White Portugal or Spanish, Burr: *White Spanish*, Ben., '86; BURR; VEG. GAR.; Vil.: Fr., Ognon jaune-soufre de' Espagne, VIL.: O. soufre d'Espagne, A. de Cl.: *O. plat dur jaune soufre d'Espagne*, Ben., '86: Ger., Schwefelgelbe Zwiebel, Vil.: *Schwefelgelbe platte runde Z.*, Ben., '88: Schwefelgelbe Spanishe Z., A. de Cl.

Bulb strongly flattened, of a peculiar brassy-yellow color; well developed samples 3 or 4 in. in diameter, 1½ to 2 in. through the axis; neck medium, root circle very small; coats firm, rather thick, very adherent; bulb very firm, productive, and keeps remarkably well; — season medium; — foliage rather abundant.

Correctly figured in Les pl. pot., p. 381; Veg. Gar., p. 366.

No. 20. TENERIFFE, Greg., '87.

Syn. *Brown Teneriffe*, Thor., '83. *Early Bermuda*, Greg., '87; "*Fegina*" from Teneriffe, 1884: Fr., Ognon de Teneriffe, VEG. GAR.; VIL.

Bulb very small; strongly flattened; pale brownish yellow, shading toward purple in many samples, sometimes strongly tinted with purple; well developed samples 1¼ in. in diameter, ¾ in. through the axis; neck and root circle very small; — foliage very scanty.

Resembles the Queen in some respects, but the outer coat is perceptibly thicker, and the flavor less mild. Grown from seed, the bulbs matured slightly later than those of the Queen, and the variety was less productive.

No. 21. YELLOW, BURR.

Syn. *Large Yellow*, Ferry, '83: Silverskin of New England, Burr.

A very old variety allied to the Brown Spanish and probably the parent of the Yellow Danvers. Bulb somewhat flattened; copper yellow, becoming somewhat deeper by age, or if exposed long to the sun; well developed samples 3 in. in diameter, 2 in. through the axis; neck very small; — foliage very abundant. The bulb is very firm, keeps well, and is of mild flavor, and excellent quality. As a market variety it has been very extensively grown in this country.

Correctly figured in Field and Garden Vegetables of America, p. 142.

No. 22. YELLOW RUSSIAN, VEG. GAR.; Vil., '84, '85, '86.

Syn. Russian Yellow, A. de Cl.: *Russian Yellow Hard Improved*, Vil., '87: Fr., Ognon dur de Russie, VIL.: *O. jaune de Russie*, Vil., '84, 85, '86: O. Russe, Vil.: Ger., Gelbe Russia Zwiebel, A. de Cl.

Bulb considerably depressed, inclining to flat on the bottom, rounding to a large neck, frequently growing double, or splitting into cloves; copper yellow, inner coats pure white, sometimes slightly greenish near the neck; well developed samples 3 in. in diameter, 2 in. through the axis; root circle small; outer coats dry, thick and firm; — foliage abundant.

"Very distinct. The bulbs keep better than those of any other variety; sometimes being fit for use nearly or quite a full year. The outer coat becomes with age as brown as a tulip bulb." Vil.

Figured correctly in Album de Clichés, No. 48,507.

No. 23. YELLOW CRACKER, Greg., '83.

Syn. Early Yellow Cracker, Greg., '87.

Resembles the Strasburg, but the bulb is more strongly flattened, being almost flat on the bottom, and decidedly earlier in season.

The remaining varieties in this division, though described separately, may not be distinct.

No. 24. LANDRETH'S GOLDEN, Land., '85, '87.

This proved quite variable in all points except in color, which was coppery yellow, with a slight luster; well developed samples 3 in. in diameter, 1½ to 2 in. through the axis. It bore considerable resemblance to the Bedfordshire Champion.

No. 25. GOLDEN QUEEN, Sib., '83; Thor., '85.

Bulb strongly flattened; dull copper yellow, usually paler toward the root, sometimes inclining to greenish on the top; well developed samples 2¾ in. in diameter, 1½ in. through the axis; neck and root circle medium; outer coat very dry and brittle, little adherent; inner coats faintly tinted with green or purple; bulb very firm, keeps well; in flavor delicate; — in season intermediate; — foliage medium.

C. Bulb red or reddish.

No. 26. BERMUDA, HEN.; Thor., '84.

Syn. *Pale Red Bermuda*, Thor., '85: *Red Pearl*, Thor., '87.

Bulb slightly oblate, sometimes approaching spherical; the dry, rather thick outer coat rather light brown, the second coat rather pale purplish red, inner coats except the center tinted with purple; well developed samples 3 in. in diameter, 2 to 3 in. through the axis; bulb firm; — season, early; — foliage medium or rather scanty; flavor mild; a poor keeper.

"A distinct sort, principally grown in the island of Bermuda, though the seed cannot be grown there. There are two varieties of it, one white and the other pale red. They are both very early, and are the varieties from which as high as 200,000 bags have been shipped from Bermuda in one season. It is now being extensively inquired for by truckers in the South. Great care should be taken in getting the seed genuine." Henderson.

No. 27. BRIGHT RED AUGUST, VEG. GAR.

Syn. *Dark Red August*, Vil., '85: Fr., *Ognon rouge vif d'aout*, VIL., '84: Ger., Carminrothe August Zwiebel, A. de Cl.

Bulb rather strongly flattened, inclining to flat on the bottom; rather pale dull red, inner coats tinged purple in the upper half; well developed samples 3¼ in. in diameter, and 1¾ in. through the axis; neck and root circle rather small; — season medium; keeps well; — foliage abundant.

Correctly figured in Les pl. pot., p. 384; Veg. Gar., p. 369.

No. 28. BRIGHT RED MEZIERES, VEG. GAR.; Vil., '87.

Syn. Fr., Ognon rouge large de Metz, Vil.: *O. rouge vif de Mézières*, Vil., '87: Ger., Carminrothe von Mezieres Zwiebel, A. de Cl.

Bulb large; strongly oblate, almost flat below, rounding slightly to the rather large neck; outer coat brownish, little adherent, second coat very bright rich, glossy red, inner coats tinted with red in the upper half; well developed samples $3\frac{1}{2}$ in. in diameter, 2 in. through the axis; root circle small; bulb very firm, flesh tender, moderately sweet, mild.

A very productive variety. The bulbs are attractive in appearance, and keep well.

Correctly figured in Les pl. pot., p. 384; Veg. Gar., p. 368.

No. 29. EXTRA EARLY RED, Hen., '87; Sib., '83; Wells, '82, '83.

Syn. *Early Flat Red*, Greg., '87: *Early Red Flat*, Thor., '84, '87: Early Red Wethersfield (d), BURR: *Extra Bloomsdale*, Land., '84: *Extra Early*, Wells, '82 or '83: *Extra Early Bloomsdale Red?*, Land., '85: Extra Early Flat Red, HEN.; Vil.

Bulb strongly flattened, bright rich red, shading in spots to deep purple, with a metallic luster in places; outer coat thin and fragile, inner coats tinted with purple toward the small neck; well developed samples 3 in. in diameter, $1\frac{3}{4}$ in. through the axis; root circle small; bulb firm; keeps well; moderately strong flavored;— foliage medium;— season very early, coming into use nearly 2 weeks earlier than the Wethersfield.

A popular variety for early market use, probably developed by selection from the Red Wethersfield.

EARLY RED GLOBE, Greg., '87, bore a very close resemblance to the above, the only difference being that the bulbs were very slightly thicker.

No. 30. FLAT MADEIRA, Thor., '83, '85.

Syn. *Flat Brown Red Tripoli*, Dam., '86: Flat Tripoli, VEG. GAR.; Vil.: *Giant Red Italian Tripoli*, Hen., '85, '87: *Large Red Italian Tripoli*, Sib., '83: Tripoli, BURR: Fr., Ognon de Madère plat, VIL.: O. de Montfrin, Vil.: O. de Tripoli, Vil.: Ger., Madeira grösste platte Riesen-Zwiebel, Vil.: Plattrunde Riesen-Madeira Z., A. de Cl.

Bulb strongly flattened; dull purplish red, or brownish below, paler about the large neck, second coat pale red, inclining to purple below, inner coats tinged with purple about the neck; well developed samples 6 in. in diameter, 2 in. through the axis; root circle very large; bulb soft, and a very poor keeper; flavor mild and delicate; — foliage medium.

This variety requires a long season, and the dimensions noted above are probably not often secured in the Northern States, where it is less reliable for crop than many others.

Correctly figured in Les pl. pot., p. 386; Veg. Gar., p. 370.

No. 31. FRENCH PALE RED, Vil., , 84.

Syn. Common Pale Red, VEG. GAR.: Fr., *Ognon rouge pâle ordinaire*, Vil., '84: Ger., Hellrothe gewohnliche Zwiebel, A. de Cl.

Bulb considerably flattened; light brown, shading in some specimens to copper red, the second and third coats a shade deeper, inclining to purple; well developed samples 3 in. in diameter, 1¼ in. through the axis; neck rather large; — season intermediate; — foliage rather abundant, but short, clear green.

Hardy, and keeps pretty well, though it sheds its outer coat readily; much grown in France.

Correctly figured in Les pl. pot., p. 383; Veg. Gar., p. 367.

No. 32. GIANT ZITTAU, VEG. GAR.

Syn. *Yellow Giant Zittau*, Vil., '84: Fr., *Ognon Géant de Zittau*, VIL., '84: Ger., Gelbe Zittauer Riesen Zwiebel, A. de Cl.

Bulb oblate; pale salmon color; well developed samples 4 in. in diameter, 2 to 2½ in. through the axis; neck and root circle small; outer coats very smooth and silky; — foliage very abundant.

A productive, firm, good keeping variety of medium season.

Correctly figured in Les pl. pot., p. 382: Veg. Gar., p. 367.

No. 33. NIORT PALE RED, VEG. GAR.

Syn. Pale Red, BURR: *Pale Red Niort*, Vil., '84: Fr., *Ognon rouge pâle de Niort*, Burr; VIL., '84: Ger., Hellrothe von Niort Zwiebel, A. de Cl.

Bulb rather strongly flattened; pale pink, slightly tinted with copper color, inner coats somewhat tinted with purple; well developed samples 3 in. in diameter, 1½ in. through the axis; neck and root circle rather small; outer coats rather thin; — season medium; flavor rather strong; bulb very firm; keeps well; — foliage very abundant, clear green.

Correctly figured in Les pl. pot., p. 383; Veg. Gar., p. 368.

No. 34. WETHERSFIELD, VEG. GAR.; Vil.

Syn. *Large Red*, BURR; Thor., '85, '87; WHITE: *Large Red Wethersfield*, BRILL; Burr; Ferry, '83; HEN., '85; Sib., '83; Wells, '83: *Wethersfield Red*, Land., '86: Fr., Ognon rouge de Wethersfield, VIL.

Bulb oblate, but not much flattened, very regular; dark purplish red, slightly glossy, often with patches approaching black, and sometimes a little metallic luster near the very small neck; inner coats stained purple in the upper half, those near the outside sometimes stained nearly to the root; well developed samples 3 in. in diameter, 2 in. through the axis; outer coat dry, rather adhesive, second rather thick and strong; root circle very small; bulb very firm; one of the best keepers and one of the most productive of all varieties; strong in flavor; — season medium; — foliage medium.

A standard variety, and a favorite in the Eastern States, where immense quantities are grown for shipment to the South and West. Named from Wethersfield, Conn.

"This onion was originally entirely spherical. Now it is rarely found, even in America, except with a somewhat flattened form, and when the original form is met with, it is called Large Red Globe Onion." Vil.

Correctly figured in Gar. for Profit, p. 251. A very fine colored plate appeared in Ferry's catalogue, 1883.

The remaining varieties in this division have been grown but once, and hence are not pronounced as being certainly distinct.

No. 35. ETNA PALE RED, Sib., '83.

Bulb much flattened; salmon rose; well developed samples 3 in. in diameter, $1\frac{1}{2}$ in. through the axis; neck small, root circle medium; bulb firm; — foliage abundant.

No. 36. MAMMOTH COPPER KING, J. & S., '86.

Bulb more or less flattened, often irregular; copper red; well developed samples $2\frac{3}{4}$ in. in diameter, $1\frac{3}{4}$ in. through the axis; neck medium; root circle rather large; bulb rather firm; a fair keeper.

No. 37. RED GENOA, Sib., '83.

Syn. *Red Bassano of Genoa*, Sib., '83.

Bulb rather strongly flattened; pale red, sometimes inclining to purple, inner coats purple about the neck, lilac below; well developed samples 3 in. in diameter, $1\frac{1}{2}$ in. through the axis; neck and root circle very small; — season rather early; — foliage rather scanty.

2. Bulb inclining to spherical.

A. Bulb white.

No. 38. ROUND WHITE SILVERSKIN, Ferry's Catalogue.

Syn. *Early White Round*, Vil., '84: *White Dutch?*, Vil., '84: White Portugal, VEG. GAR.; Vil.: White Round Early Hard Dutch, A. de Cl.: White Round Hard Dutch, Vil.: Fr., *Ognon blanc rond dur de Hollande*, VIL., '84: Ger., Runde harte weisse Holländische Zwiebel, Vil.: Silberweisse Hollände rund harte Z., A. de Cl.: Holl., Zilverwitte winter nijen, Vil.

Bulb spherical, but inclining to conical above; dull white; well developed samples 2 in. in diameter, 1½ in. through the axis; neck and root circle medium to small; — season medium; — foliage scanty.

Differs from most other white onions in the thickness of its outer envelopes. These are strong and opaque instead of being thin and fragile and almost transparent, as in many others. It keeps nearly as well as the best keeping red varieties, and the bulbs do not become green on exposure to light, as do many other white onions. It is moderately productive.

Correctly figured in Les pl. pot., p. 378; Veg. Gar., p. 363.

No. 39. WHITE GLOBE, Burr; Sib., '83; Vil., '85.

Syn. Globe Silverskinned, VEG. GAR.: *Southport White Globe*, HEN., '85: Fr., *Ognon blanc globe*, VIL., '84: Ger., Weissekugelrunde Zwiebel, A de Cl.

Very similar to the Red Globe, except in its color, which is silvery white, sometimes slightly greenish; inner coats pure white, or faintly tinted with green; well developed samples 3 in. in diameter, 2¾ in. through the axis; neck medium, root circle small; bulb firm, keeps fairly well; — foliage very abundant.

"A great favorite in the New York market." Hen.

Correctly figured in Les pl. pot., p. 379; Veg. Gar., p. 364.

No. 40. WHITE LISBON, Burr; Sib., '83; Veg. Gar.; Vil.

Syn. Early Lisbon, Burr: Florence, Vil.: Lisbon, Burr: White Florence, Burr: Fr. Ognon blanc d' Espagne, Vil.: O. blanc gros, VIL.: Ger., Lissaboner weisse grosse runde Zwiebel, Vil.: Französische or Spanische weisse Z., Vil.: Weisse dicke runde späte Z., A. de Cl.

Bulb nearly spherical, being usually slightly flattened, often irregular; white; well developed samples 3 to 4 in. in diameter, 2½ to 3 in. through the axis; neck and root circle rather large; bulb not firm; does not keep well; — season late; — foliage abundant, light green.

"Most often used green, even in the South. In England it is cultivated in immense quantities for use when quite young, when the bulbs are scarcely larger than a walnut." Vil.

Correctly figured in Les pl. pot., p. 379; Veg. Gar., p. 364.

B. Bulb yellow or brownish.

No. 41. YELLOW DANVERS, Sib., '83; Vil.; Wells, '83; White.

Syn. Danvers, BURR: *Danvers Yellow*, Burr; Land., '86; VEG GAR.: *Danvers Yellow Globe*, Sib., '83: *Early Round Yellow Danvers*, Greg., '87: Large Yellow Globe, Vil.: *Round Yellow Danvers*, Hen., '87: *Yellow Globe Danvers*, HEN., '85; Thor., 85, '87; Till., '87: Fr., Ognon jaune de Danvers, Vil.: Ger., Gelbe von Danvers Zwiebel, A. de Cl.

Bulb spherical, or slightly oblate; light yellowish brown below, paler, sometimes greenish yellow in the upper half, second coat pale yellowish brown in the lower half, dull yellowish brown above; inner coats pure white except near the neck, where they are faintly tinged with pale yellowish green; well developed samples 3 in. in diameter, 2¾ in. through the axis; neck medium; root circle ⅜ to ½ in. in diameter; bulb very firm, and an excellent keeper; flavor mild; — season medium or rather early; very productive; — foliage rather scanty.

Originated at South Danvers, Mass., prior to 1850, through selection from the yellow, or Silverskin onion of New England. It is one of the most popular varieties for field culture in this country. Some seedsmen recognize two strains, in one of which the bulb is nearly or quite spherical, and in the other quite oblate. The original form, however, was spherical.

Correctly figured in Les pl. pot., p., 380; Veg. Gar., p. 365.

No. 42. YELLOW GLOBE, BURR; Thor., '87.

Syn. *Southport Yellow Globe*, HEN., '85.

Scarcely different from White Globe except in its color, which is light yellowish brown, sometimes inclining to greenish toward the neck; inner coats pure white or faintly tinged green in the upper half; well developed samples 3 in. in diameter in both directions; neck rather large; root circle small; bulb firm, keeps well; very productive and of excellent quality; — foliage abundant.

Correctly figured in Gar. for Profit, ed. 1887, p. 252.

No. 43. YELLOW TREBONS, VEG. GAR.

Syn. Large Yellow Trebons, A. de Cl.: *Trebons Large Yellow*, Vil., '84: Fr., *Ognon jaune de Trébone*, VIL., '84: Ger., Gelbe grosse von Trebons Zwiebel, A. de Cl.

Bulb roundish, but perceptibly tapering toward the neck and root; pale yellow, or flesh color, second coat bright yellow; well developed samples 2½ in. in both directions; neck small; — flesh tender, mild and sweet; bulb moderately firm, keeps rather poorly; — foliage abundant.

"Raised in the neighborhood of Tarbes in the Hautes Pyrenées, but it is poorly fixed, even in its own country." Vil.

Correctly figured in Les pl. pot., p. 382; Veg. Gar.

C. Bulb red, or reddish.

No. 44. EARLY RED GLOBE, Greg., '87.

Syn. *Red Globe Early*, Fer., '83.

This appears to be a globular form of the Extra Early Red, maturing nearly as early as that variety; well developed samples 3 in. in diameter; neck small; flesh mild and tender; bulb very handsome in appearance.

No. 45. GIANT ROCCA, HEN., '85; Thor., '85, '87; VEG. GAR.: Vil.

Syn. *Giant Rocca of Naples*, Sib., '83: Large Brown Globe, Vil.; Fr., Ognon géant de Rocca, VIL.: Ger., Rocca Riesen Zwiebel, Vil.

Bulb somewhat variable as grown at the Station from seed, being sometimes slightly oblate, tapering more or less distinctly to the root; and at others rather oblong oval; rather light reddish yellow, with little luster; inner coats slightly tinged purple near the medium to large neck; well developed samples about 3 in. in diameter in both directions; root circle rather large; outer coat rather thick and brittle, little adhesive; bulb rather soft, and a poor keeper; mild;—foliage medium or rather abundant.

"To obtain the largest growth, the smallest bulbs should be set out the next spring, when they will continue increasing in size, instead of producing seed, as is the case with American onions." Ferry's catalogue, 1887.

The cut given in Ferry's catalogue of 1882 more nearly represents this variety as grown at the Station, than the one in Les pl. pot., p. 387; Veg. Gar., p. 371.

No. 46. GLOBE MADEIRA, Thor., '83, '85.

Syn. *Giant Red Italian Tripoli*, Hen.,'85: Globe Tripoli, VEG. GAR.; Vil.: Large Globe Tripoli, Burr: *Large Red Italian Tripoli*, Sib., '83: Madeira, BURR; Veg. Gar.: *Mammoth Pompeii?*, Till., '85: *Mammoth Tripoli*, Greg., '87: Fr., Ognon de Bellegarde, Burr; Vil.: O. de Madère rond, Burr; VIL.: O. Gros brun, Vil.: O. Romain, Burr; Vil.: Ger., Madeira grösste runde Reisen-Zweibel, Vil.: Runde Riesen Madeira Z., A. de Cl.

Bulb spherical, or slightly oblong, sometimes tapering slightly toward the root; salmon rose, or light copper red; inner coats tinted with purple toward the large neck, elsewhere pure white; well developed samples as grown at the Station from seed, 4 in. in diameter in both directions; outer coat thin and fragile, not adhesive; root circle large, though not large in comparison to the size of the bulb; the latter is soft and a very poor keeper, but remarkably sweet and mild in flavor;—foliage rather abundant, clear green.

Under favorable conditions this variety is said to have attained a diameter of seven inches. It succeeds especially in warm climates, where it is esteemed for its large size and sweet taste. It is not much grown in the northern states.

Correctly figured in Les pl. pot., p. 386; Veg. Gar., p. 370.

No. 47. RED GLOBE, H. & W., '85; Sib., '83.

Syn. *Large Red Globe*, Thor., '85: *Large Red Globe Southport*, Hen., '85: *Southport Late Red Globe*, Greg., '87: Southport Red Globe, HEN.

Bulb spherical, or very slightly oblate; purplish red, slightly glossy, shading in places to nearly black in the upper half, with small spots having a metallic luster, second coat a shade lighter, but still often nearly black about the neck, inner coats tinted with purplish red in the upper half, and sometimes in the lower half also; rather small; well developed samples 3½ in. in diameter in both directions; root circle about ½ in. in diameter; — foliage abundant.

A very productive variety, having a firm bulb that keeps well. In season it is rather late, but may be successfully grown in all except the most northern states. It is thought by M. Vilmorin to be a globular form of the Wethersfield.

The cut of "Southport Large Yellow Globe" onion, Gar. for Profit, p. 252, would represent the Red Globe quite as well.

The following variety has been grown but once, and is not pronounced as being certainly distinct.

No. 48. GIANT SANGUINIA, Dam., '86.

Bulb spherical, or slightly flattened, dull copper red; well developed samples 3½ in. in diameter, 2½ in. through the axis; neck rather small; root circle large; bulb soft; a poor keeper.

3. Bulb inclining to top-shape.

B. Bulb brownish.

No. 49. ST. LAURENT, A de Cl.

Syn. *Large Brown St. Laurent*, Vil., '87; Fr., Ognon de St. Laurent, A de Cl.: *O. jaune brun de St. Laurent*, Vil., '87: Ger., St. Laurent Zwiebel, A. de Cl.

Bulb large, rather light brown, with reddish longitudinal marks, second coat pale green, inner coats white, tinted with green near the large neck; well developed samples 3 in. in diameter, 2½ through the axis; root circle medium; flavor rather strong; — season very late; — foliage very abundant.

A very productive variety. Its keeping qualities have not yet been tested.

Correctly figured in Album de Clichés, No. 48,505.

C. Bulb reddish.

No. 50. JAMES'S KEEPING, BURR; Vil., '84; VEG. GAR.

Syn. James's Long Keeping, Burr: Fr., *Ognon de James*, Burr; VIL.,'84.

Bulb copper color, second coat reddish brown; well developed samples 2 in. in diameter, 2½ in. through the axis; neck very small; flavor strong; — season early; — foliage abundant.

Though much prized in England for its long keeping, this variety failed to keep well at the Station.

" Originated by a Mr. James, an extensive market gardener in Surrey, England." Burr.

4. Bulb oval, or pear-shaped.

A. Bulb white.

No. 51. PEAR-SHAPED WHITE, Vil., '84.

Syn. White Pear-shaped, VEG. GAR.: Fr., *Ognon piriforme blanc*, VIL., '84.

Bulb much the shape of a pear with the stem downward, rounding to a large neck, but tapering regularly to the root; white, without luster in the outer coat, sometimes faintly tinged with yellow or pink in spots; well developed samples grown at the station from seed, 1⅝ in. in diameter, 2¼ in. through the axis; bulb firm; — season late; keeps well; — foliage extremely abundant.

The form of this onion is well illustrated by the figure in Les pl. pot., p. 388; Veg. Gar., p. 371.

B. Bulb yellow.

No. 52. PEAR-SHAPED EARLY YELLOW, Vil., '87.

Syn. Fr., Ognon jaune piriforme hâtif, Vil., '87: Ger., Frühe gelbe Birn-Zwiebel, A. de Cl.

Bulb pyriform, or regularly oval; skin pale yellow, the outer coat scarcely adherent; well developed samples 2 in. in diameter, 3 in. through the axis; neck and root circle very small; flesh white, firm, very sweet, mild; — season intermediate.

Correctly figured in Album de Clichés, No. 48,535.

C. Bulb red.

No. 53. PEAR-SHAPED, Burr; Vil.

Syn. Fr., *Ognon piriforme*, Ben., '86; VIL.: O. piriforme rouge, A. de Cl.: Ger., Birn-Zwiebel, Vil.: Frankische lange Z., Vil.: Rothgelbe lange Birn-Z., A. de Cl.

Very similar to the Pear-Shaped White except in its color, which is copper red; well developed samples 2½ in. diameter, 4¾ in. through the axis; bulb firm, keeps well; of good quality, but late.

Correctly figured in Les pl. pot., p. 388; Veg. Gar., p. 371.

No. 54. PYRAMID OR VESUVIUS, Till., '85.

Bulb oval, often tapering slightly to both ends; dull pale red, second coat rather rich glossy purple, sometimes shading to nearly white below, inner coats pure white or cream tinted; well developed samples measure 2½ in. in both directions; neck and root circles rather large; outer coat thick, brittle, somewhat adhesive; bulb very soft, and a poor keeper; — foliage rather scanty.

No. 55. POTATO ONION, BRILL; BURR; HEN.; VEG. GAR.; VIL.; WHITE.

Syn. Underground onion, Burr: Fr., Ognon patate, VIL.: O. sous terre, Vil.: Ger., Kartoffelzwiebel, Vil.; Holl., Aradappel Uie, Vil.

Distinct in producing neither seed nor bulblets on the stalks, but instead the bulb set into the ground in spring divides into 4 to 10 cloves or bulbs of varying size. These when well developed are 2½ to 3 in. in diameter, and 1½–2 in. through the axis; copper yellow, with a rather thick skin; mild and sweet.

The earliest dry onions are usually obtained from this variety. It does not keep well, but is said to keep best when the tops are cut off two or three inches above the bulb at the time of harvesting.

Correctly figured in Vick's catalogue, 1883, and later years.

No. 56. TOP ONION.

In 1883 a few bulbs bearing the above name were purchased at a seed store, from which the plants differed in some respects from either the Egyptian or Catawissa onion as described by Vilmorin, though they chiefly resembled the latter. They produced bulblets at the top of the stem, and some of these produced secondary bulblets. But in addition to these flowers and seeds were also formed, the peduncles growing out from between the bulblets. With the exception of the latter peculiarity the resemblance to Vilmorin's description of the Catawissa onion was quite close.

The seeds from some of the plants were planted the following spring. They germinated and produced bulbs of fair size, which formed neither seeds nor bulblets on the top of their leaves. The bulbs were copper colored, about 2 in. in diameter and about the same through the axis, tapering toward the neck and root; they were moderately firm, and did not keep very well.

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CELERIAC.

The varieties are few in number, and differ chiefly in the amount of foliage and in the size and neatness of the roots, the latter being almost entirely enveloped in side roots in less improved varieties, and tolerably free from them in those more improved. The varieties described appear fairly distinct.

[The history of Celeriac is particularly interesting, as we seem to have a record of its first introduction, and of a size at that time which is not approached in modern culture.

Jo. Baptista Porta, a Neapolitan, thus writes in his "Villæ, lib. XII.," published at Frankfurt in 1592, lib. X., chap. XXI, De palustri apio and capitato, the translation being liberal:

"There is another kind of celery called Capitatum, which is grown in the gardens of St. Agatha, Theano and other places in Apulia, granted from nature and unseen and unnamed by the ancients. Its bulb is spherical, nearly of the size of a man's head. It is very sweet, odorous and grateful. Except in rich land, it degenerates, until it differs from the common apium (smallage?) in no respects, except in its root, round like a head." — E. L. S.]

DESCRIPTION OF THE VARIETIES.

No. 1. APPLE, Thor., '83; Vil., '84.

Syn. Apple Shaped, VEG. GAR.: *Apple Shaped Small Leaved*, Vil., '87: Dwarf Apple Shaped, HEN.: *New Apple*, Thor., '84, '85: Fr., *Céleri-rave pomme à petite feuille*, VIL., '84, '87; Ger., Runder kurzläubiger Apfel-knoll-Sellerei, Vil.

Root slightly depressed; very smooth, with few side roots; about ½ thicker than the neck; — foliage dwarf, very deep green; leaflets not blistered, inclining to spoonform; petioles rather flat, deep green, with a very broad furrow above, which in some plants is tinged with purple; the outer petioles are sometimes much washed with red; flesh white, with translucent rays, tender.

The root in this variety is more neatly formed than in any other tested.

Correctly figured in Les pl. pot., p. 77; Veg. Gar., p. 191; Gar. for Profit, ed. 1887, p. 190.

No. 2. COMMON, VEG. GAR.

Syn. *Turnip Rooted Celeriac*, Thor., '84: Turnip Rooted Celery, Veg. Gar.: Fr., Céleri rave ordinaire (d), VIL.: Ger., Leipziger Knoll-Sellerei, Vil.: Naumburger, K. S., Vil.

Root roundish or conical in the upper part, dividing into numerous more or less fleshy and tangled ramifications; well developed samples 2 in. in diameter;—foliage more vigorous than in most other varieties, but less developed than in celery; petioles hollow, more or less tinted with red or bronze, neck nearly as thick as the root.

Correctly figured in Gar. for Profit, ed. 1887, p. 189; Les pl. pot., p. 77; Veg. Gar., p. 191.

No. 3. ERFURT, Vil., '84.

Syn. Early Erfurt, VEG. GAR.: *Erfurt Giant*, Hen., '87: *Erfurt Large Early*, Sib., '85; Vil., '87: *Erfurt Short Leaved*, H. & S., '86: *Large Early Erfurt*, Hen., '84: Fr., *Céleri-rave d'Erfurt*, VIL., '84, '87: Ger., Erfurter Knoll-Sellerie, ∩il.

Root considerably depressed, slightly thicker than the neck, somewhat smaller than that of the Smooth Paris, rather smooth above, rooty below; — foliage inclining to upright, stems strong, tapering, more or less tinged with purple on both sides; — flesh tender, sometimes hollow in the center.

No. 4. PRAGUE, VEG. GAR.

Syn. *Giant Prague*, ∩il., '84: *Giant Smooth Prague*, Vil., '85: Fr., *Céleri-rave géant de Prague*, ∩il., '84, '85.

Root large, considerably depressed, inclining to flat on the bottom, tapering rather slowly to the neck, which is nearly as thick as the root; side-roots very few, but base roots large and numerous; well developed samples 2½ in. in diameter, 1½ in. through the axis; — foliage spreading, rather scanty, very deep, but dull green, with a somewhat leaden tint; — leaflets short and broad, smooth, usually nearly flat; petioles more slender than those of the Erfurt, somewhat washed in the furrows with purple; — flesh white, with translucent rays.

"May be described as a highly developed form of the Erfurt." Veg. Gar.

No. 5. SMOOTH PARIS, VEG. GAR.

Syn. *Large Smooth Paris*, Vil., '84, '85: Fr., *Céleri-rave gros lisse de Paris*, VIL., '84, 85.

Roots usually slightly depressed, thicker than the neck, and fairly symmetrical, though considerably enveloped in rootlets; — foliage dwarf, rather spreading; the broad furrows on the upper side of the rather numerous petioles usually strongly tinged purple.

INDEX TO CELERIAC.

The figures refer to the number of the variety in the described list.

[Synonyms are printed in Italics.]

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Apple Shaped 1
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    géant de Prague 4
    gros lisse de Paris 5
    ordinaire 2
    pomme à petite feuille 1
Common 2
Dwarf Apple Shaped 1
Early Erfurt 3
Erfurt 3
Erfurt Giant 3
Erfurt Large Early 3
Erfurt Short Leaved 3
Erfurter Knoll-Sellerie 3
Giant Prague 4
Giant Smooth Prague 4
Large Early Erfurt 3
Large Smooth Paris 5
Leipziger Knoll-Sellerie 2
Naumburger Knoll-Sellerie 2
New Apple 1
Prague 4
Runder kurzläubiger Apfel-Knoll Sellerie 1
Smooth Paris 5
Turnip Rooted Celeriac 2
Turnip Rooted Celery 2

CELERY.

From the names in our seed catalogues, the varieties of celery would appear to be rather numerous. As a matter of fact, however, those that are clearly distinct are quite few. In the following described list the attempt has not been made to discriminate between clearly marked varieties and strains. For convenience the so-called "red" or "pink" varieties are grouped by themselves, as are the self-blanching sorts. The term red, as applied to celery, tends to confusion, as none of the varieties are more than partially colored red, and others called red are but very slightly tinted.

DESCRIPTION OF VARIETIES.

A. Stems neither self-blanching nor tinted with red.

No. 1. BOSTON MARKET, Breck, '85; Evt., '85; Fer., '83; Greg., 86; Sib., '83; VIL.; VEG. GAR.

Rather closely allied to the Sandringham, from which it differs in being slightly taller and in being more given to suckering. The very numerous solid stems blanch nearly white, are of superior quality, and keep very well during winter.

Very popular in the neighborhood of Boston, and in some other localities. Quality excellent.

No. 2. CRAWFORD'S HALF DWARF, Greg., 86.

Syn. ? *Crawford's Half Dwarf White*, Thor. '83, '85: Early Dwarf Solid White (d), WHITE: *Henderson's Half Dwarf*, HEN., '85: Fr., Célerie pleine blanc (d), VIL.

Stems of medium length and number, growing erect, entirely solid, blanching promptly to a yellowish white, and of superior quality;—season somewhat earlier than the Boston Market.

Very largely grown for the New York market.

No. 3. CURLED SOLID WHITE, VEG. GAR.

Syn. *Curled?*, H. & S., '86: *White Solid Curled*, Vil., '84: Fr., *Céleri pleine blanc frisé*, VIL., '84: Ger., Weisser krausblättriger, Bleich-Sellerie, Vil.: Vollrippiger krausblättriger Sellerie, A. de Cl.

Very distinct from its curled foliage, which is clear, or rather pale green, decidedly glossy, with remarkably broad, deeply cut, much blistered leaflets, which have undulate, sometimes almost ruffled borders, and the segments are more pointed than in most other varieties. "The stalks are thickish and perfectly solid, and the leaves, instead of being bitter, like those of other kinds, have a mild flavor, and can be used in salads. This new variety was raised in the neighborhood of Niorte (Vendée), and began to be distributed about the year 1870." Veg. Gar.

In our experience at the Station this variety appeared somewhat difficult to blanch well.

Correctly figured in Les Pl. Pot., p. 74; Veg. Gar., p. 188.

No. 4. DWARF SOLID WHITE, VEG. GAR.

Syn. Dwarf Large Ribbed Solid, Vil.: *Dwarf Large Ribbed White Solid*, Vil., 84: Large Dwarf Solid White, Vil.: Fr., *Céleri pleine blanc court à grosses côtes*, VIL., '84: Ger., Niedriger weisser breitrippiger Sellerie, Vil.: Vollrippiger dicker niedriger weisser S., A. de Cl.

Plant dwarf, compact, with numerous very broad, solid, erect stems which are crisp, mild and tender; — foliage deep green, with large, oblong, blistered, more or less twisted leaflets, which are often somewhat spoon-form. "The stalks are more largely developed in proportion to the dimensions of the leaves in this variety than in any other." Veg. Gar.

Correctly figured in Les Pl. Pot., p. 75; Veg. Gar., p. 189.

No. 5. FERN-LEAVED, Dam., '86.

Syn. *Carter's Fern-Leaved*, H. & S., '86: *New Fern-Leaved*, Burpee, '86; J. & S., '86.

Very distinct; leaves finely divided into narrow linear segments, which are slightly curved, but are not twisted. The stems are numerous, but very slender, often hollow, and very poor in quality.

No. 6. GIANT WHITE SOLID, Brill; Thor., '83, '85.

Syn. ?*Large White Solid*, Land., '86: *Mammoth*, Dam., '86: Mammoth White (d), VEG. GAR., Vil.: Turkey or Prussian (d), Burr: Fr., Céleri Turc (d), VIL.

A very vigorous, tall-growing celery, of which the plant often attains a height of 2 ft. or more. The stalks are solid, thick and long, but are not readily blanched in the upper part. Comparatively little grown at the present time.

No. 7. GOLDEN DWARF, Sib., '83; Land., '86.

Syn. Henderson's Golden Dwarf (d), HEN.: *New Golden Heart Half Dwarf?*, Thor., '83, '85.

Similar to Crawford's Half-Dwarf, but the heart blanches to a beautiful waxen, golden yellow, making it very attractive in appearance. It is solid, keeps very well, is of superior quality, and is one of the most popular of all varieties.

No. 8. SANDRINGHAM, Hen.

Syn. Dwarf Solid White, VEG. GAR.: Dwarf White Solid, BRILL; Vil.: *Henderson's Dwarf White*, Hen., '85: Incomparable, Veg. Gar.: Incomparable Dwarf White, Vil.: *Sandringham Dwarf*, Greg., '86; Sib., '83: *Sandringham Dwarf White*, Land., '86; Thor., '85: *Turner's Dwarf White*, Sib., '83: *Turner's Incomparable*, Greg., '86: Fr., Céleri pleine blanc court hâtif, Vil.

Plant stocky, with numerous broad, perfectly solid, half round, stems, which blanch readily to a yellowish white, and are crisp, tender and of very fine flavor.

Said to have originated in the garden of the Prince of Wales. A superior variety where it can be grown without blight, to which it is more subject than many others.

No. 9. SOUP, VEG. GAR.; Vil., '84.

Syn. Small Dutch, BURR: Fr., Céleri à couper, VIL.: *C. à couper petit*, Vil., '84: C. creux, Vil.: C. fin de Hollande, Vil.: Ger., Schnitt Sellerie, Vil.: Gerwöhnlicher Schnitt Sellerie, A de Cl.: Flam., Snijselderij, Vil.: Span., Apio de cortar, Vil.: A. pequeno, Vil.

A variety of celery apparently but little improved from the wild state, grown for the leaves, which are used in flavoring. At the Station, the foliage was quite variable, the stems often hollow, and the suckers very numerous. It is said that the foliage grows again when cut.

Correctly figured in Les Pl. Pot., p. 76; Veg. Gar., p. 190.

Besides the varieties above described, the following have been tested, most of which appeared not clearly distinct.

No. 10. EARLY ARLINGTON, Greg., '85, '86.

Allied to Boston Market, but more vigorous, and three or four weeks earlier.

No. 11. LA PLUME CHESTNUT, Greg., '83, '86.

Resembles Crawford's Half Dwarf; has a superior nutty flavor; a very good variety.

No. 12. PERFECTION HEARTWELL, Greg., '86; Sib., '83; Thor., '85.

A very vigorous variety, apparently allied to Crawford's Half Dwarf.

No. 13. SEALEY'S LEVIATHAN, Vick, '85.

Apparently closely allied to Giant White Solid, if not identical with it.

No. 14. SEYMOUR'S SOLID WHITE, Sib., '83.

A large growing celery resembling Giant White Solid.

No. 15. SOLID IVORY, Greg., '84, '86.

Similar to Sandringham, but blanching perfectly white.

No. 16. WHITE CURLED GIANT OF NAPLES, Dam., '86.

Allied to the Fern Leaved, but the leaves less finely divided.

No. 17. WHITE SKAGIT, Till., '85.

A white celery of rather feeble growth. Stalks narrow at the base, tapering gradually; very mild in flavor; a poor keeper.

No. 18. WHITE WALNUT, Thor., '83, '85.

Somewhat resembles Crawford's Half Dwarf. Stems medium in size, little furrowed, very crisp, tender and mild.

B. Stems not self-blanching, but more or less washed or tinted with red.

No. 19. CARTER'S CRIMSON, Greg., '83.

Syn. Carter's Incomparable Crimson, Vil.: *Dwarf Crimson*, Sib., '83: *Hood's Dwarf Red*, Hen., '84; Vil.: *Incomparable Dwarf Crimson*, Thor., '85.

Closely resembles the Dwarf Red Solid, if not identical with it. Described by Vilmorin as being less solid than the other red celeries.

No. 20. HENDERSON'S ROSE, HEN.

Syn. *Henderson's New Rose*, Hen., '85, '87: *New Rose Dwarf*, Greg., '87.

This appears to be closely allied to the Red Solid, but the plant is perhaps rather more Dwarf; the quality is excellent.

No. 21. LAING'S MAMMOTH RED, Ben., '83.

Syn. Giant Red, Vil.: Laing's Improved Mammoth Red (d), BURR: Laing's Mammoth (d), Vil.: Manchester Red (d), VIL.; VEG. GAR.: Sutton's Prize Pink, Vil.: *Sutton's Sulham Prize?*, Ben., '83.

A very vigorous variety, of which the stems are somewhat tinted with red; of good quality, and has been described as the largest celery in cultivation.

No. 22. MAJOR CLARK'S PINK, Hen., '83, '86.

Probably identical with Major Clark's Solid Red, Vil. (Syn., Wilcox's Dunham Red, Ramsey's Solid Red, Turmos Red).

A variety of vigorous growth, with deep green foliage, and slightly tinted stems; of excellent quality.

No. 23. RED GIANT SOLID, Vil., '84.

Seemed closely allied to Carter's Crimson. The stems were a little more tinged with red, which was the only difference observed.

No. 24. RED SOLID, BURR; WHITE.

Syn. *Cole's Solid Red*, H. & S., '86: Dwarf Red Solid, BRILL: Ivery's None-such, Vil.: London Market Red, Vil.: *London Red*, Greg., '86: New Large Purple, Burr: New Large Red, Burr: *Red Giant Solid*, Vil., '84: Tours Purple, Burr: Fr., Céleri pleine violet, Vil.: Céleri violet de Tours, VIL.: Span., Apio lleno rosado, Vil.

"The plant grows to a large size, full-hearted, with a thick stem. Leaf stalks thick, deeply furrowed, and very solid, of a dark red or purplish hue where exposed, rose-colored where partly blanched; but the perfectly blanched portion is pure white, more so than the blanched part of the white varieties. Crisp, of excellent flavor, and unquestionably the best variety of red celery." Burr.

C. Stems distinctly self-blanching.

No. 25. GOLDEN YELLOW, VEG. GAR.

Syn. *Eureka Self Blanching?*, Ev., '86, '87: *Golden Self Blanching*, Burpee, '86: *Yellow Golden Solid*, Vil., '84: Fr., Céleri Chemin, Vil.: *C. pleine blanc doré*, Vil., '84.

A variety of self-blanching celery of recent introduction, which originated with M. Chemin, near Paris, from the Sandringham celery.

Late in the season the foliage, which is quite dwarf and inclined to blister, assumes a yellowish color, and without banking, the inner stems blanch to a creamy white clear to the tips. Stems rather slender, tender, mild and crisp.

Readily distinguished from the White Plume by the yellowish tint of its stems and by its dwarfer, more yellowish foliage.

Correctly figured in Veg. Gar., p. 188.

No. 26. WHITE PLUME, HEN,; VEG. GAR.

Syn. *Henderson's White Plume*, Greg., '84; Hen., '84, '87: *Improved White Plume?*, Thor., '85.

The plant when young is little paler in color than in the Sandringham and other varieties of its class. But on the approach of autumn weather, the heart leaves become paler, and by the middle of October they have changed to a pure white; those about them take on a creamy white, spotted with pale green, and of the outermost leaves the ribs and veins are white. The stems are not numerous, but with the exception of the upper half of the outer row blanch completely without other banking than is sufficient to cause the stems to grow upright. When grown without banking, the stems are rather less mild and tender than in other varieties equally well blanched by banking. It is one of the earliest of all varieties, and the perfectly blanched central leaves are very attractive on the table. It does not, however, keep well as a winter celery.

Introduced in 1884 by Messrs. Henderson & Co., of New York. A bunch of plants is well illustrated in Gar. for Profit, ed. of 1887, p. 186.

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The figures refer to the number of the variety in the described list.

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SPINACH.

The varieties of spinach are not numerous, and for the most part are not clearly defined. With the exception of the Prickly-Seeded, which some botanists have ranked as a distinct species, the chief differences between the varieties described in this article lie in their vigor, hardiness and time of running to seed. In the more improved varieties the leaves are thicker, more succulent and less distinctly hastate than in those less improved, but in all the leaves incline to hastate.

[Spinach appears to have been introduced into Europe through Spain by the Mauro-Spaniards. According to Beckman, the first notice of its use as an edible in Europe occurs in 1351 in a list of vegetables used by the monks on fast days, but in the Nabathean agriculture in Spain, in the twelfth century, Ibn-al-Awam speaks of it as a prince of vegetables. Albertus Magnus, who lived in Germany, and died in the year 1280, knew the prickly seeded form, and the Ortus Sanitatis, of 1511, figures the spinach and gives a Greek name, *aspenach.* It was also well known to Agricola in 1539. In England, the name *spynoches* occurs in a cook book of 1390 compiled under the name of "The Forme of Cury" for the use of the court of King Richard the Second; in 1538 it is spoken of by Turner in his Libellus as well known in England, and in 1536 by Ruellius as if well known in France. These dates are interesting, as De Candolle calls it new to Europe in the sixteenth century, and other authors date its first mention in England as not preceding 1568. The smooth-seeded spinach is described by Tragus in 1552. According to Sprengel, spinach is noticed by Crescentius in the thirteenth century, and is badly figured in the Ortus Sanitatis, edition of 1491, c. 450. According to Bretschneider, it is noticed in a Chinese work on Husbandry, of the seventh or eighth century. I find no early notice of its introduction to America, but in 1806 three varieties were known to our gardens.—E. L. S.]

With the exception of the Prickly-Seeded, which is sufficiently distinct to form a separate class, the names in the following described list are arranged in alphabetical order.

DESCRIPTION OF THE VARIETIES.

A. Seeds not prickly.

(Spinacia glabra, Mill. Dict., S. oleracea, L. var. B.)

No. 1. BLOOMSDALE, Land., '85; Greg., '87.

Syn. *Bloomsdale Savoy*, H. & W.,'85: *Curled-Leaved Savoy or Bloomsdale*, Thor., '87.

A somewhat improved strain of the Savoy-Leaved, introduced several years ago by D. Landreth & Sons, of Philadelphia, and specially recommended by them for sowing in early autumn for early winter use, or in late autumn to produce plants for early spring use.

No. 2. FLANDERS, Vil.

Syn. *Broad Flanders*, Vil., '84: *Round Flanders*?, Thor., '85.

Closely resembles the Round Leaf, but the plant grows a little larger, the leaves are rather more rounded, and the seeds are perceptibly larger.

A hardy variety, recommended especially for fall sowing.

No. 3. LETTUCE LEAVED, Vil., '84; BURR; VEG. GAR.

Syn. Fr., *Épinard à feuille de laitue*, VIL., '84: É. d' Esquermes, Vil.: E. oreille d' elephant, Vil.; Burr: É. Gaudry, Vil.; Burr: Ger., Salatblättriger Spinat, Vil.: Lattichblättriger Sp., Vil.: Lattachblättriger sehr breiter Sp., A. de Cl.

Plant very deep green, compact, spreading; leaves large, on short petioles, rounded at the extremity.

Productive, of excellent quality, and slow in running to seed; good for spring sowing.

Correctly figured in Les pl. pot., p. 206.

No. 4. LONG STANDING, Sib., '83; Vil., '84; Thor., '85.

Syn. Late Seeding or Long Stander, VEG. GAR.: *New Long Standing*, Thor., '87: Fr., *Épinard lente à monter*, VIL., '84: Ger., Breit spät aufschiessender spinat, A. de Cl.

A strain of the Lettuce-Leaved spinach of recent introduction and running to seed later than any other sort. It forms low, compact tufts, with numerous deep green leaves, which are rather less rounded and more blistered than those of the Lettuce-Leaved; petioles very short.

The plant does not develop very rapidly in early spring, but its superiority is noticeable in the summer months, when it continues to produce tender leaves when other sorts have run to flower.

Correctly figured in Les pl. pot., p. 206.

No. 5. NORFOLK SAVOY-LEAVED, HEN.

Syn. *Henderson's Norfolk Savoy-Leaved*, Hen., '85, '87.

An improved strain of the Savoy-Leaved, being much more vigorous than the old variety, without losing any of its hardiness. It closely resembles Bloomsdale, but in our trials with spring sown seed it ran to seed considerably earlier than that sort.

Recommended only for fall sowing, for which purpose it is one of the best.

No. 26. ROUND LEAF, HEN.

Syn. *Extra Large Round-Leaved*, Greg., '84, '87: Round Dutch, Burr: *Round Leaved*, Thor., '87: Round Seeded Round-Leaved Large Dutch, VEG. GAR.: *Round or Summer*, Sib., '83: Summer or Round Leaved, BURR: Fr., Épinard de Hollande, (d) VIL.: É. rond, Vil.: Grand épinard, Vil.: Gros E., Vil.: Ger., Breitblättriger holländischer Spinat, Vil.: Port., Espinafre de semente redonda, Vil.

A hardy, large, vigorous variety, rather distinctly hastate, with leaves which are somewhat blistered, and clear green in color.

This variety is sufficiently hardy to endure the winter, and is grown both as a summer and a winter spinach.

The Lettuce-Leaved has frequently been sold for this variety.

No. 7. SAVOY-LEAVED, Sib., '83; VEG. GAR.

Syn. *American Savoy*, Thor., '85: *Savoy-Leaved Round Seed*, Vil., '84: Curled or Savoy-Leaved (d), Vil.; VEG. GAR.: Fr., Épinard à feuille cloquée, Veg Gar.: É. de Savoy, Vil.: Ger., Savoyer breitblättriger Spinat, Vil.

Plant vigorous, leaves numerous, thick and succulent, rather broad, rounded at the end, strongly blistered, somewhat rolled.

Succeeds best when sown in autumn. Sown in spring it runs to seed earlier than some other varieties.

No. 8. THICK-LEAVED, HEN., '85; H. & W., '85.

Syn. *New Thick-Leaved*, Hen., '87: *Thick-Leaved Round*, Sib., '83.

Closely resembles the Lettuce-Leaved, and may be identical with it; one of the most popular market sorts, producing large, thick, strong, somewhat blistered leaves. It is hardy, and equally well adapted for spring or fall.

No. 9. VIROFLAY, Sib., '83; Vil., '84.

Syn. *Large Round-Leaf Viroflay*, HEN., '87: *Large Round Viroflay*, Thor., '87: Viroflay Giant, VEG. GAR.: Fr., *Monstreux de Viroflay*, VIL., '84: Ger., Grösster rundblättriger Riesen-Spinat, Vil.: Viroflay sehr breitblättriger Spinat, A. de Cl.

Plant extremely vigorous, sometimes attaining a diameter of 20 to 24 in. In character of growth it resembles the Thick-Leaved and Flanders varieties, but far surpasses either in size. It attains its superior dimensions only under exceptionally high culture.

Correctly figured in Les pl. pot., p. 206.

B. Seeds prickly.

(Spinacia oleracea, L., var. a.)

No. 10. PRICKLY-SEEDED, Vil.

Syn. *Extra Large Prickly or Winter*, Vil., '84: Large Prickly Seeded, BURR: Large Winter, Burr: *Prickly or Winter*, Sib., '83: *Prickly*, HEN.; Thor., '85, '87: Fr., Épinard à longue feuille d'hiver, Vil.: É. d'Angleterre, VIL.: Ger., Englischer, breiter scharfsamiger Spinat, A. de Cl.: Langblättriger Winter spitzsamig S., Vil.: Port., Espinafre de semente picante, Vil.

The seeds of this variety are quite different from those of the other varieties here described, being armed with sharp spines, while in all the others they are roundish and smooth. The leaves are also more distinctly hastate than in most other varieties. When sown thinly, the plants form broad, spreading tufts, with numerous branches well furnished with leaves, and rather slow to flower.

This variety is chiefly grown as a winter spinach, and is very hardy. It is less grown at the present time than formerly, being largely superseded by the more productive varieties.

Correctly figured in Les pl. pot., p. 204.

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The figures refer to the number of the variety in the described list.

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- *Bloomsdale Savoy* 1
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- *Breiter spät aufchiessender Spinat* 4
- *Broad Flanders* 2
- *Curled or Savoy-Leaved* 7
- *Curled Leaved Savoy or Bloomsdale* 1
- *Englischer breiter scharfsamiger Spinat* 10
- *Épinard à feuille cloquée* 7
  - *à feuille de laitue* 3
  - *à longue feuille d'hiver* 10
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- *Éspinafre de semente pecanto* 10
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- *Grand épinard* 6
- *Gros épinard* 6
- *Grösster rundblättriger Riesen-Spinat* 9
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Viroflay sehr breitblättriger Spinat	9

CUCUMBERS.

Setting aside the Snake cucumber and the West India gherkin, which are distinct botanical species, the other varieties described in this article are readily separated into two classes by the color of the fruit in its younger stages of growth, which in some sorts is distinctly whitish, while in others it is green.

A. Young fruit, green. Nos. 1-18 incl.

B. Young fruit, white or greenish white. Nos. 19-24 incl.

DESCRIPTION OF THE VARIETIES.

A. Young fruit, green.

No. 1. BISMARCK, Greg., '84, '86, '87.

Said to be a cross between White Spine and Long Green. Closely resembles Tailby's Hybrid in its general character, but the fruit matures somewhat earlier, and is on the average of a rather less intense deep green.

No. 2. BROWN NETTED, VEG. GAR.; Vil.

Syn. Khiva, Veg. Gar.; Vil.: *Khiva Netted*, Ben., '86: *Netted Russian*, Vil., '84: *Russian Netted*, Greg., '83, '86, '87; Ben., '86; Vil., '87: *Russian Netted Cluster*, H. & S., '86: Fr., Concombre agourci de Russie, Vil.: *C. brodé de Khiva*, Ben., '86: C. brodé de Russie, VIL.: *C. brodé de Russie ou agourci*, Vil., '87: Ger., Braune genetzte Chiwa Trauben-Gurke, Vil.: Braune genetzte Walzen Trauben-G., Vil.: Braune genetzte Lucas'sche Trauben-G., Vil.: *Kurze Netz-Gurken aus Chiva*, Ben., '86: *Kurze russiche Netz-Gurken*, Ben., '86: Russische Netzgurke, A. de Cl.

Ripe fruit small, oval, dark russet brown; skin very tough and hard, covered with a rather fine whitish net-work of shallow cracks; well developed samples 4 or 5 in. long, about 3 in. in diameter; — at table size the fruit is very slightly warty, without prickles, rather distinctly furrowed, deep green at the stem, shading to nearly white at the blossom end; flesh greenish white, thin and seedy; — plant moderately vigorous, very productive, margin of leaves often entire; — season a little later than that of Early Russian.

Correctly figured in Les pl. pot., p. 160; Veg. Gar., p. 221.

No. 3. EARLY CLUSTER, BURR; BRILL; Greg., '86, 87; Hen.; WHITE.

Syn. *Boston Pickling* (incorrectly), Sib., '83: *Short Prolific Pickling*, Land., '85, 87.

Ripe fruit rather long oval, or short club-shaped; brownish yellow; considerably cracked; often with a few black prickles that rub off very easily; well developed samples 5 or 6 in. long, 2 to 2½ in. in diameter; — at table size dark green at the base, striped and speckled with paler or yellowish green; nearly round in section; little prickly; flesh thin and seedy; — at pickle size clothed with rather numerous black prickles; — plant moderately vigorous, very productive; — season early.

Recommended more for table use than for pickles.

NOTE. — In the true Early Cluster, the fruits are literally produced in clusters, three or more appearing at the same node; but judging from the samples tested, this quality seems to have been largely lost.

No. 4. EARLY FRAME, BURR; Greg., '86; Sib., '83; WHITE.

Syn. *Boston Pickling*, Greg., '86; VEG. GAR.; VIL.; Thor., '87: *Early Green Cluster*, Thor., '87 (not of Burr): *Early Short Green*, Thor., '83, '87: *Extra Early Green Prolific*, Hen., '87 (a little earlier than the others): *Green Prolific Pickling*, Greg., '86, '87: Short Green, Burr.

Resembles the Early Russian, but the vine is rather more vigorous and the fruit nearly double the size, besides being usually several days later. Ripe fruit oblong oval, often swollen towards the blossom end; brownish yellow; skin much cracked; well developed samples about 6 in. long, 2½ to 3 in. in diameter;—at table size quite warty, with very short black prickles that easily rub off; obscurely three-sided; furrowed; very deep green at the stem, shading to yellowish green at the blossom end; flesh greenish white, rather seedy, but tender; — plant moderately vigorous; foliage very deep dull green;—season early.

"Very productive, succeeds well, whether grown in open culture or under glass, and if plucked while small makes an excellent pickle." Burr.

No. 5. EARLY RUSSIAN, BURR; BRILL; Greg., '86; HEN.; Thor., '86, '87.

Syn. *Borowskian*, H. & S., '86: *Muromian*, H. & S., '86: *Russian Shortest Green*, Ben., '86: *Russian Small Earliest Pickling*, H. & S., '86: *Russian Small Early*, Vil., '84: *Small Early Russian*, Vil., '87: Early Russian Gherkin, VEG. GAR.: Extra Early Russian Gh., Vil.: Russian Gh., Vil.: Fr. Concombre à bouquet, Vil.: C. d'Italie, Vil.: C. de Pologne, Vil.: *C. de Russe*, VIL., '84, '87: C. Mignon, Vil.: *C. vert court de Russie très hâtif*, Ben., '86: Petit concombre, Vil: Ger., *Kurze russische grüne Treib-Gurke*, Ben., '86: Russische kleine Trebi-G., Vil.: Russisehe kurz Treib-G., A. de Cl.

Ripe fruit very irregular oval; smooth; brownish yellow; skin rather finely cracked; well developed samples 3 to 4 in. long, 2½ in. in diameter; — at table size, dark green at the base, shading to white at the bottom end; obscurely three-sided; slightly furrowed; not warty but with numerous very small black spines; flesh greenish white, very thin, tender;—at pickle size, the fruit is slightly warty;—plant a feeble grower, running but 2 to 3 ft.; very productive, generally producing its fruit in pairs; foliage grayish green; leaves nearly entire, only the youngest ones distinctly lobed.

Generally conceded to be the earliest variety of cucumber now extant, maturing about ten days before the Early Cluster.

Correctly figured in Les pl. pot., p. 160; Veg. Gar., p. 221; Gar. for Profit (ed. 1887), p. 202.

No. 6. EXTRA LONG SMOOTH, Greg., '86.

Syn. *Extra Long Green Smooth*, Greg., '83, '87.

Ripe fruit more or less distinctly club-shaped, tapering slowly toward the stem, rounding at the blossom end, often somewhat crooked, with usually a very few black spines; nearly round in section; dull orange, inclining to brownish; well developed samples 12 in. long, 2½ to 3 in. in diameter; — table size more cylindrical than club-shaped, but tapering abruptly to the stem, obscurely three-sided; very dark green near the stem, shading to paler at the blossom end, with a few scattering black spines; flesh greenish white, very thick, tender; — at pickle size, furrowed; densely covered with small black spines; — plant moderately vigorous and productive; foliage deep green; — season medium; or rather late.

No. 7. EXTRA LONG WHITE SPINED, Thor., '83, '87; VIL.

Syn. *Evergreen White Spine*, J. & S., '86 : Long White Spine, VEG. GAR.

A strain of the White Spined bearing rather longer fruits, but scarcely differing from it in other respects; well developed samples, when ripe, 10 to 12 in. long.

No. 8. JERSEY PICKLE, Land., '85, '87.

This resembled the Early Cluster in its external characters, but the fruit was rather more cylindrical, and somewhat later in maturing. It is especially recommended for pickling, and is said to "green" better than any other.

No. 9. LANDRETH'S FIRST, Land., '85.

Syn. *Landreth's First Early*, Land., '87.

This appears to be a shorter form of the Long Green Turkey, though it seemed somewhat mixed with Long Green. In season quite early.

No. 10. LONG GRECIAN, Thor., '87.

Syn. Athenian, Veg. Gar.: *Athens*, Vil., '84: *Grecian*, Vil., '84: *Long Green Smooth from Athens*, Greg., '84, '86, '87: Fr., Concombre grec., Vil.: *C. long vert d'Athens*, VIL., '84: Ger., Griechische glatte Walzen-Gurke, Vil.: Grieschische von Athens Gurke, A. de Cl.

Ripe fruit cylindrical, or approaching club-shaped; very smooth, sometimes slightly furrowed; rich yellow, inclining to brown in places; surface slightly cracked; well developed samples 12 in. long, 3 in. in largest diameter; — at table size, bright green at the base, shading to nearly white at the blossom end; surface irregular and furrowed, but not warty, with numerous very small black spines; flesh white, thick, tender and crisp; — at pickle size long, slender, tapering, furrowed except near the stem, scarcely warty, but covered with small spines; — plant very vigorous, but not productive; leaves large.

Correctly figured in Les pl. pot., p. 164; Veg. Gar., p. 224.

No. 11. LONG GREEN, Greg., '86; Sib., '83; Thor., '87; Vil.

Syn. *Common Long Green*, VEG. GAR.; Vil., '84: *Long Green Turkey*, (incorrectly), Thor., '87: Fr., *Concombre vert long ordinaire*, VIL., '84.

Ripe fruit cylindrical, rounding at both ends, often swollen somewhat at the center, or toward the blossom end, often somewhat crooked; smooth; brownish yellow; well developed samples 10 to 12 in. long, 2½ to 3 in. in diameter; — at table size long cylindrical, not furrowed, often almost round in section, smooth; very deep green, with some whitish green stripes at the blossom end, retaining its green color until almost full grown; nearly free from spines; flesh white, very thick, tender and crisp; — at pickle size, irregular cylindrical, dark green at the stem end, but pale, or whitish green in the greater part of its length; — plant vigorous and productive; — season medium.

A very popular variety both for table use and for pickles.

The IMPROVED LONG GREEN, Fer., '83; IMPROVED LONG GREEN PRICKLY, Greg., '86, '87; LONG GREEN SERPENT, Dam., '86, and GREEN ITALIAN SERPENT, Dam., '86, appeared very closely allied to this variety, many of the fruits of all appearing strictly identical, while others differed somewhat in length, form, or in the number of spines.

No. 12. LONG GREEN CHINESE, VEG. GAR.

Syn. *Green Long China*, Vil., '84: *Very Long Green China*, Vil., '85: Fr., *Concombre vert très long de Chine*, VIL., '84, '85: Ger., Lang Chinesische glatte Schlanger Gurke, A. de Cl.

Ripe fruit cylindrical or club-shaped, often slightly crooked, obscurely three-sided; smooth; yellowish white; well developed samples 12 in. long; — at table size, rather pale green, with whitish longtitudinal lines in the part toward the blossom end, and white spines that easily rub off; flesh very white, tender, thick; — plant vigorous, productive; — season medium.

Correctly figured in Les pl. pot., p. 165; Veg. Gar., p. 225.

No. 13. LONG GREEN TURKEY, BURR.

Syn. Extra Long Green Turkey, Burr: *Turkey Long Green*, Land., '85.

Differs from the Long Green in having the fruits more distinctly club-shaped, considerably longer, sometimes reaching a length of 18 in., without being larger in diameter; rather deeper green at table size, and having thicker and firmer flesh. The part toward the stem is quite seedless, being solid to the center; hence the variety produces few seeds, on which account it is often difficult to obtain it pure. The solid neck is not regarded an advantage by all, as this portion is often tough and bitter, rendering it undesirable for slicing. In season it is medium; in quality, good both for table use and pickles.

No. 14. MEAUX GREEN PICKLING, Vil., '87.

Syn. Fr., *Concombre à cornichons fin de Meaux*, Vil., '87.

Ripe fruit intermediate in size between Long Green and Nichol's Medium Green; club-shaped or cylindrical; often crooked; smooth; rich yellow, mottled with brown; skin more or less cracked; — at table size deep green at the base, slightly mottled with paler green, glaucous through the center, with some small warts, surmounted with blackish spines; blossom end pale green, with whitish stripes; flesh very thick, tender and crisp; — at pickle size rather pale green; tapering to a blunt point; warty, with numerous soft yellowish prickles; — plant moderately vigorous, leaves sharply lobed, the terminal lobe distinctly elongated; season medium.

NOTE. — An examination later in the season disclosed no perceptible differences between this and the Long Green.

No. 15. MONROE'S VERY LONG GREEN, Vil., '84.

Syn. Fr., *Concombre vèrt long de Monroe*, Vil., '84.

Ripe fruit club-shaped, often curved; pale yellow, more or less washed with russet; well developed samples 9 in. long, 3 in. in diameter; — at table size, warty and spiny; — plant very vigorous and productive,

This is probably one of the English "ridge" cucumbers.

No. 16. NICHOL'S MEDIUM GREEN, Hen., '86; Thor., '87.

Ripe fruit oblong oval, sometimes cylindrical or club-shaped' usually nearly round in section; yellow, orange, or brownish; skin somewhat cracked; well developed samples 5 to 8 in. long, 2½ in. in diameter; — at table size intense green; nearly smooth, though sometimes distinctly furrowed; almost without prickles; flesh thick, remarkably tender; — at pickle size tapering, pale glaucous green; slightly warty, with rather numerous but short black prickles; — plant moderately vigorous, very productive; — season rather early.

Of recent introduction, very popular; recommended both for open and forced culture, for table use and pickles.

NOTE — Three cucumbers, viz., SHORT FRENCH PICKLING, Greg., '86, '87, SHORT PICKLING, Greg., '86, and SHORT GREEN, Greg., '86, so nearly resembled the above, as grown at the Station, that they could hardly be described as distinct, except a slight difference in the time of maturity. The last was considerably later than the other two, and these were somewhat less early than Nichol's Medium Green.

No. 17. TAILBY'S HYBRID, Greg., '83, '86; Rice, '83; Thor., '87.

Ripe fruit obscurely club-shaped, or cylindrical,usually more or less distinctly three-sided; white; usually retaining more or less of its spines; well developed samples 11 in. long, 4 in. in greatest diameter; — at table size very dark, almost blackish green, often very finely mottled with paler green, and obscurely striped toward the blossom end, with a few scattering and conspicuous white spines that easily rub off; flesh white, very thick, tender and crisp; — at pickle size deep green, furrowed, with numerous small warts, and short white spines; — plant very vigorous, with large deep green leaves, remarkably productive; — season late.

Said to be the result of a cross between the Early White Spine, and one of the largest English frame cucumbers. It is a very hardy and desirable variety.

No. 18. WHITE SPINED, BURR; WHITE.

Syn. Early White Spine, BRILL: Early White Spined, Burr: *Improved Early White Spined*, Thor., '87: *Improved White Spine*, HEN.; Sib., '83: *Improved White Spined*, Greg., '86: New York Market, Burr: *O. K. Perfect Pickling*. Ev., '85: *Peerless*, Thor., '84, '87: *Peerless White Spine*, Greg., '84, '85, '86: White Spined Long Green, WHITE.

Ripe fruit cylindrical, sometimes a little club-shaped, usually obscurely three-sided, regular; smooth; greenish white; well developed samples 9 in. long, 2½ to 3 in. in diameter; — at table size deep green at the base, shading to paler, or yellowish green about the blossom end, where it is obscurely striped with yellowish green, somewhat glaucous; spines white, rather sparse, short, on small warty excrescences, easily rubbing off; flesh white, very tender, crisp, and of excellent flavor; — at pickle size, quite glaucous and warty in the outer half; — plant very vigorous and productive.

One of the most popular varieties, specially recommended for table use; it is said to retain its green color after picking better than other sorts.

B. Young fruit white, or greenish white.

No. 19. EARLY WHITE, VEG. GAR.

Syn. *White Early*, Vil., '84: Fr., *Concombre blanc hâtif*, VIL., '84: Ger., Weisse frühe Gurke, Vil.

Ripe fruit oblong-cylindrical; entirely smooth; somewhat triangular in section; almost pure white, with the slightest greenish tint; well developed samples 9 in. long, 3 in. in diameter; — at table size greenish white, with numerous very small white spines; — plant not a vigorous grower; — season rather early.

No. 20. EARLY YELLOW DUTCH, VEG. GAR.; Vil., '84, '87.

Syn. Fr., Concombre jaune hâtif de Hollande, VIL.: Ger., Gelbe Holländische sehr frühe Gurke, Vil.: Gelbe Holländische sehr frühe G., A. de Cl.: Holl., Lange gele Komkommer, Vil.

Ripe fruit oblong, oval or cylindrical, obscurely three-sided; often furrowed and somewhat crooked, with numerous very small black prickles; rich yellow, inclining to orange or brownish; well developed samples 8 to 10 in. long, 2½ to 3 in. in diameter; — at table size greenish white, rather slender, slightly furrowed, and a little warty; spines not at all conspicuous; flesh greenish white, very thick, tender and crisp; — at pickle size whitish green, tapering, smooth and a little swollen at the base, elsewhere furrowed and covered with short blackish spines; — plant vigorous, moderately productive; foliage rather light green; leaves distinctly lobed and serrated; — season rather early.

Correctly figured in Les pl. pot., p. 162; Veg. Gar., p. 222.

No. 21. LANDRETH'S WHITE SLICING, Land., '84, '87.

Ripe fruit oblong oval, smooth and regular; rich yellow, sometimes inclining to russet; skin very slightly cracked; well developed samples 8 in. long, 3 in. in diameter; — at table size rather irregular, furrowed and warty; nearly white, with a few blackish spines that easily rub off; flesh white, moderately thick, very crisp, tender; — at pickle size almost pure white, with numerous black spines; — plant vigorous and productive; leaves large, rather pale green; — season medium.

This variety seems intermediate between the white and russet cucumbers. It differs from the Early Yellow Dutch in being more russet at maturity, and in having blackish instead of white spines.

No. 22. LARGE WHITE BONNEUIL, Greg., '84, '85, '86, '87.

Syn. Bonneuil Large White, VEG. GAR.: Fr., Concombre blanc très gros de Bonneuil, VIL.: C. blanc gros, Vil.: Ger., Weisse sehr dicke von Bonneuil Gurke, A. de Cl.

Ripe fruit oval, or cylindrical, often much swollen at the center, and sometimes very irregular, obscurely three-sided, smooth; white; well developed samples 10 in. long, 4 in. in longest diameter; — at table size the fruit has numerous very short obscure spines that easily rub off; — at pickle size whitish green, with very numerous small warts, completely covered in the greater part of its length with white or transparent prickles; flesh very thick, often seedless in the half towards the stem, tender and crisp; — plant very vigorous, productive; leaves large, the older ones nearly entire; — season medium.

Correctly figured in Les pl. pot., p. 161; Veg. Gar., p. 222.

The cucumber most generally grown about Paris for the use of perfumers.

No. 23. WHITE GERMAN, Greg., '83, '85, '86, '87.

Ripe fruit long, rather slender cylindrical or club-shaped, nearly or quite round in section; very smooth; creamy or ivory white; well developed samples 12 to 15 in. long, 3 in. in diameter; — at table size greenish white, somewhat warty and spiny, obscurely furrowed; flesh white, very thick and tender; — at pickle size a shade more greenish; — plant vigorous and productive, with large, deep green leaves; — season medium.

No. 24. WHITE JAPAN, Greg., '85; Till., '85.

Syn. *Early White Japan*, Thor., '85, '87.

Ripe fruit oblong oval, rather regular, usually rounding rather abruptly to both ends, obscurely three-sided, somewhat furrowed; without spines; white, or faintly tinged yellow; well developed samples 8 in. long, 2½ to 3 in. in diameter; — at table size somewhat furrowed and warty; greenish white; flesh white, rather thin, tender; — at pickle size very pale green, tapering, with numerous white spines; — plant moderately vigorous; productive; leaves distinctly lobed; — season rather early.

No. 25. SNAKE CUCUMBER, VEG. GAR.; Vil., '84.—*Cucumis flexuosus* L. *Cucumis Melo* L. *var.*

Syn. Fr., Concombre de Turquie, Vil.: *C. serpent*, VIL., '84: Ger., Schlangen-Gurke, Vil.: Schlangen Melone, Vil.: Holl., Vlangen melone, Vil.: Ital., Anguria, Vil.: Cocomero torto, Vil.: Popone serpentino, Vil.

Ripe fruit very long and slender, usually with distinct longitudinal furrows, but not regularly ribbed, usually very crooked, thicker toward the blossom end than near the stem; sometimes slightly netted toward the blossom end; yellowish green; well developed samples 2 to 3 ft. long; flesh with a rather marked melon flavor; — plant not very vigorous; leaves rather pale grayish green, roundish cordate, not lobed, margin sharply toothed, surface not blistered; stem and petioles very hairy; flowers resembling those of the melon.

"The snake cucumber is a true melon. Sometimes the same stem bears slender, snake-like fruits, and others that are oval and inflated; sometimes even the same fruit is slender and more or less snake-like near the stem, but swollen at the extremity, assuming the appearance of a melon." Vil.

Correctly figured in Les pl. pot., p. 166; Veg. Gar., p. 226.

No. 26. WEST INDIA GHERKIN, Greg., '87; Hen.; Vil. *Cucumis Anguria L.*

Syn. *Burr Cucumber*, Greg., '87: Gherkin, WHITE: Prickly Gherkin, VEG. GAR.: Small Gh., Thor., '87: *Small West India Gh.*, Vil., '84: West Indian Gh., Veg. Gar.: Fr., Angurie, Vil., Concombre à épines, Vil.; C. d'Amerique, Vil.: C. cornichon des Antilles, Vil.: *C. des Antilles*, VIL., '84: C. marron Vil.: sometimes improperly called C. Arada, Vil.: Ger., West indische Gurke, Vil.

Ripe fruit regularly oval; covered with fleshy protuberances resembling spines; pale yellow; $1\frac{1}{2}$ to $2\frac{1}{2}$ in. long, $1\frac{1}{4}$ to $1\frac{1}{2}$ in. in diameter; before maturity the fruit is pale green, with whitish, longitudinal stripes; flesh very thin, white, with an agreeable cucumber taste; — plant very vigorous, spreading; stem slender, covered with rough hairs; leaves resembling those of the water melon, divided into 5 to 7 roundish, toothed lobes; male flowers very small, borne on short, peduncles, female flowers on long slender peduncles.

This plant is not strictly a cucumber, but is usually classed as such. It is used for pickles.

Correctly figured in Les pl. pot., p. 167; Veg. Gar., p. 226.

INDEX TO THE CUCUMBER.

The figures refer to the number of the varieties in the described list.

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Extra Long Smooth 6
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Gelbe Holländische frühe Gurke 20
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SQUASH AND PUMPKIN.

As used in this country, the names squash and pumpkin appear to have little, if any, reference to botanical distinctions in the cucurbits to which they are applied. In general terms, a cucurbit grown for table use is a squash, and one grown for stock is a pumpkin, but both words are sometimes applied to the same fruit by different observers. Evidently, then, no classification based upon botanical characters can separate the so-called pumpkins and squashes.

Botanists refer the numerous cultivated varieties of these cucurbits to three species, viz., Cucurbita maxima, Duch.; C. moschata, Duch, and C. Pepo, L. In this article, the varieties are first referred to their proper botanical species, after which they are classified with reference to the more conspicuous characters of the fruit. The descriptions of the species are taken from the contribution by Alfred Cogniaux to DeCandolle's Monograph of the Phanerogams, Vol. 3, pp. 544–546.

1. Cucurbita maxima, (Cogn.) Leaves harsh, with five rounded lobes, almost without sinuses between; hairs of the petioles stiff, but never pungent; peduncles terete; calyx tube of the male flowers ob-conical, never constricted beneath the insertion of the corolla, segments linear or thread-form; fruit-bearing peduncle thick, corky, striate, but never truly sulcate.

Stem sub-terete, trailing, elongated, [rarely quite short], leaves more or less reniform; corolla campanulate, intense yellow with reflex lobes; fruit-bearing peduncle cylindrical or club-shaped; fruit often very large, pulp scarcely fibrous, placentæ spongy, not readily deliquescent; seeds ovate, scarcely margined, white or yellow.

2. C. Pepo, (Cogn.) Leaves harsh, with five lobes which are acute and often lobulate; sinuses usually deep, acute or rounded; hairs of the petioles and of the nerves on the under side of the leaves rather stiff, often pungent; peduncles of the flowers obtusely pentagonal; calyx tube of the male flowers campanulate, constricted beneath the insertion of the corolla, the segments fleshy or corky; fruit-bearing peduncle often woody, polyhedral, sulcate, little expanded at its union with the fruit.

Stem long-creeping, or rarely short, angular, sulcate; leaves sometimes marbled with ashy white; calyx tube obscurely five-angled; corolla golden yellow; lobes reflexed or erect; fruit extremely variable, blackish green, golden yellow, yellow, or white or versicolor, ribbed or not ribbed, smooth or warty, small or large, often obovoid; pulp fibrous, placentæ readily deliquescent; seeds distinctly margined, broadly or narrowly ovate.

3. C. moschata, (Cogn.) Leaves soft, with five or six acute or rarely obtuse lobes, with acute sinuses between, [in our cultivated varieties more often not cut, but presenting more or less distinct angles]; hairs of the petioles and nerves never pungent; peduncles of male flowers sub-terete, or terete, of female ones pentagonal; calyx tube of male flowers short or wanting; segments flat, linear, apex usually dilated,

foliacious, or lobed; fruit-bearing peduncle often woody, polyhedral, sulcate, distinctly expanded at its union with the fruit.

Stem trailing, rarely abbreviated, sub-terete, or obscurely pentagonal, often black spotted at the nodes: leaves intensely green, frequently with white angular spots, roundish reniform, margin crenulate-denticulate; calyx intensely green; corolla, pale yellow; fruit usually cylindrical, blackish green or golden yellow; when mature often covered with a thin whitish bloom; pulp scarcely fibrous, placentæ readily deliquescent; seeds dirty white, distinctly margined.

CONSPECTUS OF THE SPECIES.

I. Plants annual.

A. Leaves harsh; calyx tube campanulate, with fleshy or corky segments.

1. Lobes of leaves rounded, scarcely any sinuses between, peduncles round. *C. maxima.*

2. Lobes of leaves acute, sinuses between them often deep, peduncles obtusely pentagonal. *C. Pepo.*

B. Leaves soft, calyx tube very short, or scarcely any, segments flat, usually dilated, foliaceous at apex. *C. moschata.*

From the above conspectus any variety may be referred to its proper species. But it is often desirable to refer a variety to its species from the fruit alone. This may be done quite readily with our cultivated varieties if the stem remains attached, by observing the following characters:

1. Fruit stem not grooved longitudinally. *C. maxima.*
2. Fruit stem distinctly grooved longitudinally.
   *A. Stem little expanded at its union with the fruit. *C. Pepo.*
   B. Stem strongly expanded at its union with the fruit. *C. moschata.*

A synopsis of the classification here adopted is as follows:

1. Fruit stem not grooved longitudinally.—*Cucurbita maxima.*
   a. Fruits distinctly ringed† about the blossom end; the "turban" squashes, "giraumons" of the French. Nos. 1–5 incl.

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* In a few cases it may be difficult to decide whether the fruit stem is much or little expanded at its union with the fruit, as the expansion is about intermediate. In such cases, a glance at the male flowers will answer the question at once. If the calyx tube is constricted a little just beneath the insertion of the corolla, it is C. Pepo; but if the calyx lobes extend almost or quite to the peduncle, and are distinctly green in color, it is C. moschata.

† The word "ringed" is here used to express the peculiar formation at the blossom end of this class of squashes, whereby the fruit appears as if it were growing about a smaller sample of a different form.

b. Fruits not ringed.
- * Fruits distinctly oblate. Nos. 6–11, incl.
- † Fruits roundish, or more or less oblong. Nos. 12–22, incl.

2. Fruit stem distinctly grooved longitudinally.

A. Fruit stem little expanded at its union with the fruit. *C. Pepo.*

a. Fruits with conspicuous projections about the circumference.
- * Fruits strongly flattened; pattypan shaped. Nos. 23–26, incl.
- † Fruits more or less oblong. No. 27.

b. Fruits warty.
- * Fruits club-shaped, the neck usually more or less crooked. Nos. 28–29.
- † Fruits oval. Nos. 30–31.

c. Fruits roundish or oblate. Nos. 32–36, incl.

d. Fruits oval or cylindrical. Nos. 37–47, incl.

B. Fruit stem broadly expanded at its union with the fruit. *C. moschata.*

a. Fruits club-shaped or pyriform; the neck usually more or less crooked. Nos. 48–50, incl.

b. Fruit oblong. Nos. 51–52.

c. Fruits distinctly oblate. Nos. 53–55, incl.

DESCRIPTION OF THE VARIETIES.

NOTE.—In the following descriptions the variety is understood to be a squash, unless the word pumpkin is appended to the name.

1. Fruit stem not grooved longitudinally: — *Cucurbita maxima.*

This species furnishes the largest fruits, as well as those of the finest quality. The flesh is almost always free from fiber, and in many of the varieties very dry, sweet and well flavored. The plants are almost without exception running, and are generally very vigorous growers. They are, however, more subject to injury from insects than those of the other species.

a. Fruits distinctly ringed about the blossom end.

No. 1. AMERICAN TURBAN, Greg., '84, '86.

Syn. *Turban*, Greg., '85; Thor., '87: *Turk's Cap or Turban*, Vick, '87.

Fruit shaped like a bowl of which the sides are nearly perpendicular, the blossom end corresponding to the bottom; the greatest diameter is often near the stem end, which is usually nearly flat, but sometimes very shortly cone-shaped; surface obscurely furrowed; skin moderately hard, deep orange, the rounded protuberances within the ring bluish white; well developed samples 10 in. in diameter, 6 in. through the axis; stem swollen near the fruit, but contracted at the union;—flesh orange, becoming very deep orange when cooked, very dry, fine grained, sweet and well flavored;—plant very vigorous; leaves deep green, undulate on the borders; petioles long, pale green, channeled, with numerous hairs; vine dark green.

The size of the ring, and the prominence of the protuberances at the blossom end vary much in different samples. In some both are almost wanting, while in others the ring is four or more inches in diameter, and the protuberances decidedly prominent.

A superior variety for autumn and winter use.

"Without doubt a combination of the Hubbard, Autumnal Marrow, Acorn and French Turban." Greg.

Correctly figured in "Squashes and How to Grow Them," Greg., p. 47.

No. 2. BAY STATE, Rawson, '87.

Fruit the form of the Essex Hybrid, the surface covered with blister-like protuberances, ribs obscure or invisible; skin pale leaden blue, mottled with whitish blue, hard and tough at maturity; well developed samples 10 in. in diameter, 8 in. through the axis; ring at blossom end distinct, narrow, the center sometimes bluish-white, and sometimes the color of the rest;—stem swollen near its union with the fruit;—flesh bright goldenyellow, fine grained, dry, sweet and well flavored;—plant rather vigorous, productive; leaves clear green, obscurely angled, smooth, dishing, border often coarsely undulate.

In season about the same as Essex Hybrid or perhaps slightly earlier; recommended as an excellent keeper.

Introduced in 1887 by W. W. Rawson & Co., Boston, Mass., and fairly well illustrated in their catalogue of that year.

No. 3. ESSEX HYBRID, Fer., '83; Sib., '83; Vick, '87.

Syn. *Low's Premium Hybrid,* Thor., '82, '85, '87.

Very similar in form and in the character of the plant to the American Turban, differing from it in being a shade darker in color, and in having a hard shell like the Hubbard;—flesh yellow, dry, sweet and of excellent flavor. It is a very productive winter squash and is especially recommended for long keeping.

Said to be a cross between the American Turban and Hubbard.

No. 4. RED CHINA, Thor,, '87.

Syn. *Red Cardinal*, Dam., '86: *Small China Turban*, Vil., '84: Small Chinese Turban Gourd, VEG. GAR.: Fr., *Giraumon petit de Chine*, Vil., '84: Ger., Genfer plattrunder Kürbiss, A. de Cl.: Chinese, Hong-nan-kona, Vil.

Fruit strongly flattened, depressed about the stem; ribs rather obscure, terminating at the ring, which is usually small; at the center of the ring is a small knob of the same color as the border; skin very hard and tough, rich orange red, with a few yellow or green longitudinal stripes; the depressed portion within the ring is sometimes green, and sometimes richly variegated with alternate irregular stripes of red, yellow and deep green. The whole fruit is sometimes somewhat warty; — flesh thin, pale yellow, dry and rather sweet; stem slender; — plant moderately vigorous; leaves rather small, pale green, entire; petioles short, usually slender, pale green, sometimes striped with whitish green; channeled, with numerous white hairs; vine slender, pale green.

Correctly figured in Les pl. pot., p. 177; Veg. Gar., p. 258.

No. 5. TREE PUMPKIN, Greg., '85, '86, '87.

Fruit rather small; oblate, or very short cylindrical, somewhat hollowed about the stem; ribs obscure, the ring rough and whitish, the center usually regular, dull, pale bluish green; the main part blackish green; well developed samples 7 in. in diameter, 5 in. through the axis; — flesh greenish yellow, dry, but rather inferior in flavor; — plant vigorous, scarcely running, often quite bushy in habit; leaves clear green, roundish cordate; petioles pale green, distinctly channeled, hairs very numerous; vine thick, deep green, angular.

The only variety of C. maxima grown at the Station in which the vine is not distinctly running.

The fruit is said be good for pies.

b. Fruits not ringed about the blossom end.

* Fruits distinctly oblate.

No. 6. BOULOGNE GRAY PUMPKIN, VEG. GAR.

Syn. *Gray Boulogne Pumpkin*, Till., '85: Fr., *Potiron gris de Boulogne*, VIL., '87.

Fruit very strongly oblate, hollowed about the stem, and at the blossom end, obscurely ribbed; skin rather soft, dark green, finely shaded and mottled with pale yellowish green; surface finely marked with short whitish corky lines; well developed samples 12 in. in diameter, 8 in. through the axis, described as sometimes attaining a diameter of 30 in.; — flesh thick, sweet and rather dry; — plant very vigorous; moderately productive; leaves entire, large, deep green; petioles often long and slender, channeled, the channels darker than the ridges, with numerous short, stiff hairs; vine dark green at the base. The fruit is said to keep well.

Of comparatively recent introduction, and much esteemed by the market gardeners about Paris. It is excellent for pies, though hardly equal to the Etampes pumpkin for this purpose.

Correctly figured in Les pl. pot., p. 173; Veg. Gar., p. 254.

No. 7. ETAMPES PUMPKIN, Veg. Gar.

Syn. *Bright Red Etampes Pumpkin*, Thor., '84: Vil, '87: *Mammoth Red Etampes* P., Greg., '86, '87: Fr., *Potiron rouge vif d'Étampes*, VIL., '87.

Fruit very large; often irregular, hollowed about the stem, sometimes also at the blossom end, at the center of which is often a small ring, with a short cylindrical protuberance at the center; ribs broad, usually rather obscure, but sometimes prominent; skin nearly smooth, rich salmon color, with occasional paler stripes, soft; well developed samples 15 in. in diameter, 9 in. through the axis; — flesh yellow, remarkably thick, fine-grained and sweet; — plant very vigorous; leaves large, smooth, clear green; petioles pale, sometimes whitish green, often striped with two shades of green, distinctly channeled, with numerous short hairs; vine large, nearly round at the base.

A superior variety for pies. The fruit keeps well.

Correctly figured in Les pl. pot., p. 172; Veg. Gar, p. 253.

No, 8. MAMMOTH, Burr; Bliss, '83.

Syn. *Jumbo Pumpkin*, Hen., '87: Large Yellow Gourd, Burr; Vil.: *Large Yellow Mammoth Pumpkin*, Vil., '87: *Mammoth Chili*, HEN.: Thor., '85, '87: Mammoth Pumpkin, Burr; VEG. GAR.; Vil.: Fr., Potiron jaune, Burr: P. jaune gros, VIL.: P. romain, Vil.: Ger., Allergrösste Riesen Centner-Kürbiss, Vil.: Holl., Groote gele reuzen meloen-pomeon, Vil.

Fruit very large; usually strongly oblate, but sometimes roundish, hollowed about the stem and at the blossom end; ribs more or less distinct; skin soft, pale salmon yellow, more or less cracked and netted at maturity; well developed samples 18 in. in diameter, 12 in. through the axis; — flesh yellow, thick, fine-grained, and sweet; — plant remarkably vigorous, sometimes running 40 feet or more; leaves very large, obscurely five-lobed or entire, clear or rather pale green, strongly dishing; petioles sometimes two feet or more long, pale green, channeled, the furrows darker than the ridges, with numerous rather stiff hairs; vine deep green towards the base, obscurely angular.

Considered the largest variety extant, specimens having exceeded 200 pounds in weight. The vines are not productive so far as the number of fruits is concerned, and they require a long season for complete development. The fruit is said to keep well, and to be of excellent quality. It is superior for pies.

No. 9. NEW MEDITERRANEAN, J. & S., '86.

Syn. Chestnut (d), VEG. GAR.: Fr., Courge châtaign, Vil.: C. marron, VIL.: C. pain des pauvres, Vil.: Potiron de Corfou, Vil.: Ger., Braunrother Kastanien Kürbiss, A. de Cl.

Fruit medium or rather small; ribs nearly or quite wanting; rich salmon color, sometimes inclining to scarlet; well developed samples 7 in. in diameter, 6 in. through the axis; stem large, short and fleshy, swollen near the center, pale green striped with white; — plant very vigorous; leaves entire, with undulate borders, apex very often retuse, dull grayish green, sometimes strongly washed with gray, rather strongly dishing; petioles slender, tall, channeled, striped more or less distinctly with light and dark green, with numerous short, white hairs; vine angular.

The plant is rather productive, and the fruit is said to keep well.

Correctly figured in Les pl. pot., p. 174; Veg. Gar., p. 255.

No. 10. POSSUM NOSE PUMPKIN, Greg., '86.

Fruit slightly oblate, hollowed about the stem, and terminating in a small cylindrical protuberance at the blossom end; ribs obscure, surface smooth, slightly warty; pale salmon color, with whitish stripes; well developed samples 9 in. in diameter, six in. through the axis; — flesh thick, rich orange; stem swollen at the center; — plant vigorous; leaves very large, deep green; petioles pale green, sometimes striped with two shades, distinctly channeled with numerous short, rather stiff hairs; vine rather slender, pale green, nearly round at the base.

Said to keep well, to be fair for table use, and excellent for pies.

No. 11. SPANISH GOURD OR PUMPKIN, VEG. GAR.

Syn. *Green Spanish Pumpkin*, Vil., '87: Spanish Gourd, Vil.: Fr., *Potiron vert d' Espagne*, VIL., '87.

Fruit medium or large; strongly oblate, distinctly hollowed about the stem and blossom end; irregularly ribbed; skin soft, dull green, mottled and netted with whitish green; well developed samples 18 in. in diameter, 12 in. through the axis; — flesh thick, very bright yellow; — plant very vigorous, moderately productive; leaves clear green, often very large, margin sinuate, surface smooth, somewhat dishing; petioles obscurely channeled, distinctly striped with two shades of green, with very short hairs; vine almost round.

Excellent for pies.

Correctly figured in Veg. Gar., p. 254.

† Fruits roundish, or more or less oblong.

No. 12. BOSTON MARROW, BRILL; Burr; Greg., '84; HEN., '85; Sib., '83.

Syn. Autumnal Marrow, BURR; Greg. (not of Vil.): Marrow, Greg.

Fruit short pyriform, sometimes approaching roundish, with a more or less distinct point at the blossom end, often terminating in a small nipple, or wart-like excrescence; ribs very obscure; skin very thin, covered with fine indentures, giving it a pock-marked appearance, orange, mottled with light cream color, rather pale when first ripe, becoming darker; well developed samples 8 in. in diameter, 10 in. through the axis; — flesh thick, salmon-color, deep orange when cooked, very sweet, dry, and well flavored; stem usually short and thick, contracted a little at its union with the fruit, and tapering slightly toward the vine, often 2 in. in largest diameter; — plant very vigorous, running 20 ft. or more; leaves large, roundish, the margin nearly or quite entire, borne on long, tapering, distinctly channeled, hairy petioles, of which the furrows are deeper green than the ridges; vine rather large, angular, deep bluish green toward the base; much branched. "Seeds large, thick, pure white." Burr.

An autumn variety that comes into use in August, and may readily be kept until Christmas or after.

Introduced about 1832 by Mr. John M. Ives, of Salem, Mass., and supposed by him to have come originally from the West Indies.—Burr.

Correctly figured in Ferry's catalogue of 1884 and subsequent years.

No. 13. BUTMAN, GREG., '84, '86; Hen., '85; Sib., '83; Thor., '87.

In form and size closely resembling the Hubbard, but without the blister-like elevations; ribs obscure, point distinct, but short, often curved; skin pale dull green, with whitish stripes and splashes; — flesh light salmon color, thick, very dry, sweet and especially well flavored; — plant vigorous; leaves large, obscurely angular; petioles striped with pale and whitish green, hairs short, rather numerous; vine blackish green at the nodes, much branched, obscurely angular.

One of the finest winter squashes. "In its prime from October to January, though as a keeper it is equal to the Hubbard." Greg.

Correctly figured in Squashes and How to Grow Them, p. 71.

No. 14. DUNLAP'S EARLY MARROW, Greg., '87.

The fruit bears a striking resemblance to that of Boston Marrow, but averages rather larger and shorter, and is 10 to 12 days earlier in maturity; well developed samples 10 in. in diameter in both directions; the smaller fruits longer in proportion to their diameter; — flesh rich yellow, of excellent quality. The plant is very productive, and its fruit is said to keep well.

No. 15. EXTRA EARLY ORANGE MARROW, Thor., '87.

Closely resembles the Boston Marrow, but the fruit is distinctly deeper in color, and a little longer in proportion to its diameter. In quality it resembles the Boston Marrow, but it is several days earlier in maturity. The plant is very productive.

No. 16. HUBBARD, BRILL; BURR; GREG., '86; HEN.; Land., '84; Sib., '83; Thor., '87; VEG. GAR.; Vil.

Syn. *Improved Hubbard*, Maule, '86: Fr., Courge vert de Hubbard, VIL.: Ger., Dunkelgrüner Hubbard Kürbiss, A. de Cl.

Fruit "spherical at the middle, gradually receding to a neck at the stem end, and to a point, usually curved at the calyx end, where it terminates in a kind of button" (Greg.); ribs rather obscure, sometimes wanting; surface overspread with numerous blister like protuberances; skin very hard and tough, dull, dark green, orange where it rests on the earth, usually with streaks of dirty white toward the blossom end, upper surface brownish when long exposed to the sun; well developed samples 10 in. long, 8 in. in longest diameter; stem irregularly striped while nearing maturity with dirty white, and two or more shades of green; — flesh very thick, rich salmon yellow, remarkably fine grained, dry, rich, and well flavored; — plant vigorous; leaves often very large, margin sinuate, finely serrate, border usually rather distinctly undulate, limb often strongly dishing; petioles long, often thicker than the stem, distinctly channeled toward the base, hairs numerous, white; vine very large, rather pale green, darker toward the base, angular, with numerous white hairs.

The standard winter squash for family use and market. It is hardly surpassed in quality, an excellent keeper, and when unripe, is superior for table use to most summer squashes. The plant is very productive, but is more subject to injury from the squash vine borer than many others. The fruit, however, is said to be less injured by frost than the Boston Marrow or American Turban.

The origin of the Hubbard is not known. According to Mr. Gregory, it was brought into Marblehead, Mass., about the year 1807, by a marketman named Green, who resided near Boston. It may have come from the West Indies.

The illustration given in "Squashes, and How to Grow Them," Greg., p. 44, is more nearly correct as to form than the one in Les pl. pot., p. 175; Veg. Gar., p. 256; but the latter shows the outer markings rather better.

No. 17. IMPROVED MAMMOTH PUMPKIN, Thor., '87.

This seemed allied to the Mammoth Squash. Fruit roundish or slightly oblong, often rather irregular, distinctly depressed about the stem, inclining to pointed at the blossom end; ribs rather distinct in some samples, almost invisible in others; skin moderately hard, mottled with salmon and rather pale yellow, with stripes of dirty white following the furrows from the blossom end about half way to the stem, which is very short and thick, and constricted at its union with the fruit; well developed samples 16 in. in diameter, 20 in. through the axis;—flesh yellow, thin for the size of the fruit, fine-grained and sweet.

The vine and foliage are scarcely different from those of the Mammoth Squash.

Excellent for pies, but rather less rich than the Etampes Pumpkin.

No. 18. LONG WHITE ITALIAN MUSHROOM, Dam., '86.

Fruit very large, oval with rather distinct ribs; white, sometimes inclining to pink, very smooth, but not glossy; well developed samples 18 in. long by 10 in. in diameter; stem short; — plant very vigorous; leaves rather pale green, slightly grayish, entire, usually bluntly pointed at apex, border plain; petioles often thicker than the vine, channeled, with numerous short, white hairs; vine slender, pale green, nearly round, rather densely clothed with white hairs.

No. 19. MARBLEHEAD, GREG., '86; HEN., '85; Maule, '86; Sib., '83.

Syn. *New Marblehead*, Thor., '85, '87.

Fruit oval, inclining to pointed at both ends; ribs very obscure; skin very dull light blue, extremely hard at maturity; well developed samples 11 in. long, 7 in. in diameter; — flesh yellow, remarkably dry, sweet and well flavored; — plant vigorous; leaves large, roundish-reniform, obscurely angled, margin finely serrate; petioles pale green, sometimes channeled towards the base, with numerous short, stiff whitish hairs; vine pale green, angular, sometimes slightly furrowed.

The plant is productive, and the fruit is said to keep rather better than that of the Hubbard.

Introduced several years ago by Mr. J. J. H. Gregory, of Marblehead, Mass.

Correctly figured in "Squashes, and How to Grow Them," p. 70.

No. 20. OHIO, Thor., '87; Greg., ? '82; Vil.

Syn. Autumnal Marrow, Vil., (not of Greg.): California Marrow, Vil.: Fr., Courge de l' Ohio, VIL.: Ger., Ohio langlichrunder gelber Kürbiss, A. de Cl.

Fruit oval, sometimes thickest near the stem, and sometimes at the center or near the blossom end; distinctly but not prominently ribbed; terminating in a slight nipple; skin moderately hard, salmon pink with a small green patch about the nipple; well developed samples 9 in. in diameter, 11 in. through the axis; — flesh rather thick, tender, fine-grained, dry, very well flavored; — plant vigorous; foliage clear green; leaves roundish, or obscurely angled, margin entire or sinuate, apex rounded, surface very smooth; petioles rather slender, channeled, with numerous very short hairs; vine large, deep green.

The cut of this squash given by Vilmorin, Les pl. pot., p. 175, is an exact representation of one form of it. As grown at the station, the fruit was as often regularly oval, or thickest toward the blossom end.

No. 21. OLIVE, VEG. GAR.; Vil., '84.

Syn. *New French Olive*, Thor., '87: *New Olive*, Thor., '85: Fr., *Courge olive*, VIL., '84: Ger., Oliven langlichrunder Kurbiss, A. de Cl.

Fruit oval, inclining to pointed at the blossom end, but rounding to the stem; skin hard, very smooth, very deep green, finely mottled and shaded with yellowish green; well developed samples 12 in. long, 6 in. in diameter; — flesh yellow, rather thick, very dry, sweet and well flavored; — plant very vigorous; leaves large, entire, obscurely angled, clear green, surface very smooth but dishing, border coarsely undulate, apex distinctly pointed; petioles nearly uniform pale green, channeled, with rather numerous short, stiff, white hairs; vine very slender, pale green, little furrowed, obscurely angular.

Of recent introduction, but one of the finest winter squashes. The plant is not very productive, but the fruit keeps well, and is scarcely excelled in quality.

Correctly figured in VEG. GAR., p. 257.

No. 22. VALPARAISO, BURR; VEG GAR.; Vil., '84.

Syn. Commodore Porter, Burr: Porter's Valparaiso, Burr: Fr., *Courge de Valparaiso*, VIL., '84: Ger., Valparaiso grosser Kürbiss, A. de Cl.

Fruit large, oval, scarcely ribbed, often terminating in a wart-like excrescence at the blossom end; surface usually more or less netted, creamy white, often with a tinge of gray; well developed samples 18 in. long, 13 in. in diameter; — flesh rather thin, rich yellow or orange, generally of good quality; — plant vigorous; leaves large, toothed on the margin, pale green, often with a peculiar grayish metallic appearance; "seeds rather large, Nankeen yellow, smooth and glossy." Burr. The fruit keeps fairly well.

Correctly figured in Les. pl. pot., p. 174; Veg Gar., p. 255.

2. Fruit stem distinctly grooved longitudinally.

A. Fruit stem little expanded at its union with the fruit: — *Cucurbita Pepo.*

a. Fruits with conspicuous projections about the circumference.

*Fruits strongly flattened, "patty-pan" shaped.

No. 23. PATTYPAN, Greg.; Vil.

Syn. Crown Gourd, Vil.: Custard G., Vil.: Custard Marrow G. (Am.), Veg. Gar.; Vil.: Cymbling, Burr: Elector's Cap, Veg Gar.: Early Bush Scallop, WHITE: Early Scalloped Bush, BRILL: Scollop Gourd, Veg. Gar.; Vil.: Fr., Arboufle d'Astrakhan, Vil.: Arbouste d'Astrakhan, Vil.: Artichaut d'Espagne, Vil.: A. de Jerusalem, Vil.: Bonnet d'Electeur, Vil.: B. de prêtre, Vil.: Couronne impériale, Vil.: Patissons, VIL.: Ger., Bischofsmutze, Vil.: Flam., Prinsenmuts, Vil.

A very distinct and peculiar form of *Cucurbita pepo*, of which several varieties or sub-varieties are cultivated, which may in the main be described together.

The form of the fruit is well suggested by the name; strongly flattened, the contour presenting five or ten rounded excrescences or teeth which incline either outward, forward, or back. The fruit is usually distinctly convex at the blossom end, and inclining to flat on the other, but sometimes the reverse is true, and at others both ends are convex; flesh rather thick, but not sweet nor very dry; skin very smooth, hard and tough at maturity; seeds small, broad in proportion to their length; stem long, slender, tapering, blackish green; — plant not running, or running but feebly; leaves large, clear green, more or less distinctly 3 or 5 lobed; petioles numerous, nearly uniform pale green, the larger ones distinctly channeled, hairs rather sparse; vine dark green, very short.

The fruits form very early, and are used while the skin may be readily pierced by the finger nail.

A plant with the fruit is correctly figured in Les. pl. pot., p. 185; Veg. Gar., p. 265.

"In the month of June large quantities are shipped from the Southern and Middle States, where they anticipate from two to three weeks the products of the home market gardeners." Burr.

No. 24. VARIEGATED PATTYPAN.

Syn. *Striped Custard Marrow*, VEG. GAR.; Vil., '85: Variegated Bush Scalloped, BURR: Fr., *Pattisson panaché*, Vil., '85.

Fruit hemispherical, nearly flat, or depressed at the stem end, projections not very prominent; creamy white, irregularly striped, with two shades of green; well developed samples about 7 in. in diameter, 4 in. through the axis; plant feebly running, runners 4 to 6 ft. long.

Very handsome, but of inferior quality. — Burr.

The cut of Patisson panaché amélioré, Les pl. pot., p. 185, Veg. Gar., p. 266, represents the above equally well, almost the only difference in the two being in size.

No. 25. WHITE PATTYPAN, Burr.

Syn. *Early Bush*, Greg., '84: *Early White Bush Scallop*, BURR; Sib., '83; Thor., '87: White Summer Scalloped, Burr: Fr., Patisson blanc, Burr (credited to Vil.).

Skin of a rather dull white color. The fruit when full grown measures 6 to 8 in. in diameter.

No. 26. YELLOW PATTYPAN.

Syn. *Custard Marrow*, Bliss, '83: *Early Golden Bush*, Thor., '87: *Early Yellow Bush Scallop*, BURR: *Golden Bush*, Greg., '84: Pattypan, Burr: Yellow Custard Marrow, VEG. GAR.: *Yellow Elector's Cap*, Vil., '85: Yellow Summer Scallop, Burr: Fr., *Patisson jaune*, Vil., '85.

Skin of uniform butter color; fruit of the size of that of the White Pattypan. By some the flesh is thought to be a little finer grained and better flavored than that of the White Pattypan.

Considered by M. Vilmorin to be the original type of the cultivated pattypan.

Correctly figured in Les pl. pot., p. 185; Veg. Gar., p. 265.

† Fruits more or less oblong.

No. 27. PINEAPPLE, Thor., '87.

Syn. *Landreth's White Turban*, Land., '84, '85, '87: *New Pineapple*, Thor., '85: *New White Pineapple*, B. M. & Co., '84.

Fruit somewhat resembling that of the White Pattypan, but decidedly longer through the axis in proportion to its diameter. The projections are disposed in 5 distinct pairs. As in the White Pattypan, these sometimes incline outward and sometimes toward the blossom end; and as in the latter the stem end of the fruit is sometimes nearly flat, and at others convex or even conical, usually with a more or less distinct narrow cavity about the stem; skin white or creamy white; well developed samples 8 in. in diameter in both directions; stem slender, little tapering or furrowed, finely and irregularly striped with light and dark green, with numerous long and very slender hairs; — flesh pale yellow, of rather good quality; — plant running, vigorous; leaves large, pale green, usually distinctly 5-lobed; petioles rather slender, often very long, little furrowed, pale green, hairs few, slender, transparent; vine very thick, deeply furrowed, almost without hairs.

The plant is very productive; the fruit is used both in its young and mature state, and is an excellent keeper.

Correctly figured in Ferry's catalogue. 1887.

b. Fruits warty.

* Fruits club-shaped, the neck usually more or less crooked.

No. 28. BUSH SUMMER CROOKNECK, HEN.

Syn. Bush Gourd, VEG. GAR.: Bush Summer Warted Crookneck, BURR: Crookneck Gourd, Veg. Gar.: Early Bush, Vil.: Early Crookneck Bush, BRILL: Early Summer Crookneck, Burr: *Summer Crookneck*, Greg., '84, '86; Thor., '87; Vil.; WHITE: *Summer Golden Crookneck*, Sib., '83: Fr., Courge coutors hâtive, VIL.: C. coutors hâtive non coureuse, A. de Cl.: C. crochue, Vil.: Ger., Früher Crookneck Kürbiss, A. de Cl.

Fruit short club-shaped, but more or less crooked toward the stem, usually terminating in a point at the blossom end; clear bright yellow; well developed samples 8 in. long, 3 in. in longest diameter; skin very hard and tough when fully mature; flesh greenish yellow, watery but well flavored; "seeds comparatively small, broad in proportion to the length, pale yellow" (Burr); — plant not running, but forming a tuft about 2½ ft. high, and 4 or 5 ft. in diameter; leaves large, clear green, little dishing, more or less distinctly 3 or 5 lobed, margin serrate;

petioles rather pale green, distinctly channeled; hairs not numerous, but rather large and stiff, translucent; vine deep green, furrowed.

One of the earliest varieties; good for use while the skin is sufficiently tender to be easily pierced by the finger nail. The fruit is sometimes dried, and used as an ornamental gourd.

Correctly figured in Les pl. pot., p. 184; Veg. Gar., p. 264.

A running variety of Summer Warted Crookneck is extant, but it has not been grown at the Station.

No. 29. LONG GREEN CROOKNECK, Land., '85.

Syn. *Long Green Summer Crookneck*, Land., '87.

Fruit club-shaped, neck usually more or less crooked; skin hard and tough, blackish green, often beautifully variegated with irregular and narrow stripes of pale or yellowish green, yellow where lying on the soil; well developed samples 14 in. long, 3½ in. in longest diameter; — flesh pale yellow, moderately dry, sweet and well flavored; stem slender, slightly tapering, deep green; — plant running vigorous; leaves large, deep green, distinctly 3 or 5 lobed; petioles pale green, rather obscurely channeled, with a few short, stiff hairs; vine very dark green toward the base, shallow, furrowed, with a few white prickles.

† **Fruits oval.**

No. 30. BRAZILIAN SUGAR, Thor., 87; Vil., '84, '85.

Syn. Brazilian Sugar Gourd, VEG. GAR.: Fr., *Courge sucrière du Brésil*, VIL., '84, '85: Ger., Brazilianischer Zucker-Kürbiss, Vil.

Fruit oval; ribs obscure; skin very hard and tough, dark green before maturity, orange when fully ripe; well developed samples 5 in. diameter, 6 in. through the axis; stem pale green, rather slender, tapering, with numerous long and slender, whitish hairs; — flesh yellow, thick, very sweet; — plant vigorous; leaves deep green, much blistered, margin rather remotely dentate; petioles uniform pale green, scarcely channeled, with a few rather strong green hairs; vine pale green, deeply furrowed, with numerous slender green hairs.

The fruit is recommended as being of good quality, and keeping well, and the plant is quite productive.

Correctly figured in Les pl. pot., p. 182; Veg. Gar., p. 263.

No. 31. NANTUCKET PUMPKIN, BURR.

Syn. Hard-Shell Pumpkin, Burr: Nigger Head P., Burr: *Negro* P., Greg., '85, '87.

Fruit roundish, sometimes oblate, or oblong; ribs obscure; skin extremely hard, very deep glossy green, faintly mottled with paler green, the excrescences marbled with yellowish green; well developed samples 8 in. in diameter, 7 in. through the axis; — "flesh comparatively thick, yellow, sweet, fine grained and of excellent flavor" (Burr); stem sometimes paler than the fruit, short, thick, slightly expanded at its union; — plant very vigorous, productive; leaves clear green, deeply 5-lobed, the terminal lobes somewhat cut, margin deeply toothed near. the petioles, which are pale green, scarcely channeled, with numerous stiff hairs; vine blackish green at the base and for a considerable distance.

The fruit keeps well, and the skin changes to yellow or orange after being stored a long time.

c. Fruits roundish or oblate.

No. 32. COCOANUT, Greg., '86; Hen., '85 (not the Cocoanut of BURR).

Syn. Little Cocoanut, Rice, '83; Thor., '82, '85, '87.

Fruit small, nearly round, hollowed about the stem, ribs numerous, distinct; creamy white, shading to rich yellow or orange in the furrows, toward the blossom end the colors change abruptly to deep, often almost blackish green; — flesh fine-grained and of excellent quality; stem very slender, very deep green, scarcely tapering; — plant running, very vigorous, much branched at the base; leaves rather distinctly 3-lobed; petioles slender, of uniform color, with few hairs; vine deep bluish green, becoming pale green farther out, furrowed, nearly destitute of hairs.

The plant is very productive; the fruit matures rather late, and keeps fairly well.

Correctly figured in Gregory's catalogue of 1882 and succeeding years.

No. 33. GENEVA BUSH, Vil., '85.

Syn. Geneva Bush Gourd, Veg. Gar.: Fr., *Courgeron de Genève*, VIL., '85.

Fruit distinctly oblate, sometimes much flattened, somewhat depressed about the stem and at the blossom end, the furrows obscure or invisible; deep green when immature, rich yellow or orange when ripe; well developed samples 6 in. in diameter, 4 in. through the axis; — flesh pale yellow, quite thin; stem pale green, tapering, hairy; — plant not running; leaves rather light green, three or five lobed; petioles pale green with deeper green stripes; vine about 2 ft. long, obscurely angular, deep green, rough, but scarcely spiny.

A summer squash of which the fruits are used before fully grown; when ripe, the skin is rather hard and tough.

Correctly figured in Veg. Gar., p. 264.

No. 34. LARGE FIELD PUMPKIN, Greg., '87.

Syn. Common Yellow Field Pumpkin (d), Burr: *Golden Marrow* P.?, Till., '85: *Michigan Mammoth* P.?, Greg., '87.

Fruit roundish, or slightly oblong, inclining to short cylindrical, depressed a little at each end; ribs numerous but not prominent; skin moderately hard, rich orange; well developed samples 15 in. in diameter, 12 to 14 in. through the axis; — flesh yellow, one to two inches thick; stem tapering, scarcely hairy; — plant very vigorous; leaves deep green, often somewhat marbled with white; distinctly 3 to 5 lobed, the terminal lobe often rather deeply cut; petioles pale green, channeled, with short stiff hairs; vine slender, deep green at the base, nearly without hairs.

Very commonly grown in the fields of Indian corn as food for stock in New England and the Middle States; and used to a considerable extent for pies. It is, however, inferior for the latter purpose to some of the larger varieties of *C. maxima*, as the flesh is more stringy, less highly flavored, and cooks less quickly. The quality varies much, and the samples having a deep orange skin, mottled with darker specks, are richest and sweetest. Before the introduction of the improved varieties of table squash, the flesh of this pumpkin was often boiled and served as a vegetable, and Mr. Burr states that during the war of the revolution it was the custom to reduce by evaporation the liquid in which the flesh of pumpkins had been cooked, as a sweetening to be used as a substitute for molasses.

No. 35. PERFECT GEM, Greg., '84; Sib., 83; Thor., '82, '84, '87.

Fruit small; oblate, depressed about the stem; ribs numerous and distinct; skin smooth, hard, creamy white; well developed samples 5 in. in diameter, 4 in. through the axis; — flesh pale yellow, dry, moderately sweet and well flavored; stem long and slender; — plant running, very vigorous; leaves very numerous, rather distinctly 3-lobed, intense deep, almost glossy green, borders finely undulate; petioles rather slender, obscurely channeled, faintly striped with two shades of green, with a few stiff white hairs; vine much branched, with numerous shallow furrows.

The plant is very productive and at first grows somewhat like a bush squash, but later numerous runners start out. The fruit begins to form late in the season, but develops quickly, and is used both green and ripe. It keeps nearly equal to the Hubbard.

The branches of the vine often grow fasciated, forming broad, flat runners, with the petioles crowded very closely, and with multitudes of female flowers.

Correctly figured in Gregory's catalogue of 1887 and previous years.

No. 36. SUGAR PUMPKIN, Burr.

Syn. *Early Sugar Pumpkin, Thor.*, '87: Small Sugar P., Burr: *Sweet P.*, Sib., '83.

Fruit roundish or oblate, depressed more or less at the ends, with numerous rather obscure ribs; skin rather hard, bright orange; well developed samples 8 in. in diameter, 6 in. through the axis; — flesh pale yellow, rather thick, sweet and fine grained; stem blackish green, somewhat tapering; — plant moderately vigorous; leaves deep green, sometimes spotted with ash-color, deeply 3 to 5 lobed, the terminal lobe more or less cut, apexes of lobes pointed; petioles obscurely channeled, often striped with two shades of green, darker towards base, with short, stiff hairs; vine blackish green at the base.

b. Fruit oval or cylindrical.

No. 37. BLACK NEGRO PUMPKIN, Thor., '87.

Fruit oval; ribs very prominent, swollen about the stem; very dark; dull bluish green, orange where in contact with the ground; well developed samples 7 in. in diameter, 10 in. through the axis; skin very hard; — flesh rich yellow, not very thick; stem large, deep green, penciled with whitish green; — plant very vigorous; leaves deep green, strongly dishing, with numerous and rather large whitish spots, deeply 5-lobed, the lobes somewhat cut and terminating in a small, elongated point; petioles pale green, darker at the base, scarcely channeled, with short, white, stiff hairs; vine large blackish green.

No. 38. CITRON BUSH, Dam., '86.

Syn. *Mandarin Bush*, Dam., '86: *New Egg-Plant*, Hen., 87.

Fruit very large; obovate or oval, rather oblong, sometimes obscurely pointed at the blossom end; ribs very obscure except about the stem; skin very hard and tough, dull yellow when fully mature; well developed samples 20 in. long, 10 in. in longest diameter; stem remarkably short, thick, rapidly tapering, deep green; — plant not running, but very vigorous, sometimes attaining a height of 3 ft.; leaves very large, sometimes 18 to 20 in. across, deeply 5-lobed, the terminal lobe distinctly notched, usually more or less dishing, deep green, on some plants strongly marked along the veins with angular, ash-colored spots, borders plain, margin rather coarsely and deeply serrate; petioles very numerous, almost concealing the vine, long, sometimes an inch and a half in diameter, but often quite slender, pale green, scarcely channeled, with a few short, stiff hairs; vine usually not more than one and a half feet long, much branched, some of the branches growing nearly upright, dark green toward the base.

No. 39. GREEN STRIPED BERGEN, BURR; GREG.; Thor., '82, '85, '87.

Syn. *Green Striped Bush*, Hen., '83, '85: *Marrow Striped Cluster*, H. & S., '87.

Fruit small, inversely bell-shaped, sometimes ovate, depressed about the stem; ribs numerous, distinct about the stem; disappearing toward the blossom end; the furrows very dark green, the ridges creamy white, with irregular spots and patches of pale and dark green; well developed samples 5 in. in diameter, 6 in. through the axis;—flesh pale yellow, rather dry, moderately sweet, not very well flavored; stem slender, very dark green, tapering, scarcely furrowed, little hairy;—plant not running, growing to a diameter of 4 or 5 ft.; leaves often very large, clear green, distinctly 3, sometimes 5-lobed, the lobes and apex rounded at the terminus; petioles rather slender, pale green, distinctly channeled, with a few rather conspicuous whitish or translucent hairs; vine pale green, angular or furrowed; male flowers on slender peduncles.

No. 40. ITALIAN VEGETABLE MARROW, BURR; VEG. GAR.; VIL.

Syn. *Italian Green Striped*, Vil., '84: Fr., Coucourzelle, Vil.: Courge Coucourzelle, Burr: *C. d'Italie*, VIL., '84: Ger., Langer Italienischer Kürbiss, A. de Cl.

Fruit cylindrical, rounding, and sometimes swollen at the blossom end, tapering to the stem, where the five rather obscure ribs are most prominent; skin very smooth, quite hard, blackish green, with irregular yellowish stripes and spots; well developed samples 18 in. long, 4 in. in diameter;—plant not running; foliage dense and compact; leaves very dark green, deeply cut, with dentate lobes; petioles pale green; vine scarcely exceeding a foot in length.

"In Italy, where this squash is very generally cultivated, the fruits are always used young, or about the size of a small cucumber; sometimes even before the flower has opened, and when the ovary is scarcely the size and length of the finger. The plants thus deprived of their young fruits continue to yield profusely for several months. Gathered at so early a stage, the fruits are said to be extremely tender and delicate." Vil.

Correctly figured in Les pl. pot., p. 182; Veg. Gar., p. 262.

No. 41. LARGE TOURS PUMPKIN, Vil., '87.

Syn. *Large Tours or Mammoth*, Hen., '87: Fr., *Citrouille de Touraine*, VIL., '87: Ger., Tours Centner-Kürbiss, A. de Cl.

Fruit very large, oblong oval or roundish, usually somewhat irregular and more or less flattened at the ends; ribs numerous, but rather obscure; skin rather soft, smooth, pale, slightly grayish green, striped and marbled with deeper shades; well developed samples 18 in. in diameter, 2 ft. through the axis; — flesh yellow, not very thick, and rather inferior in quality; plant vigorous; leaves deep green, sometimes very slightly washed with white, very large, lobes often sinuate, and sometimes cut in the younger leaves, surface inclining to blister, often wrinkled along the midrib; petioles pale green, obscurely channeled, with rather sparse, short stiff hairs; vine deep green toward the base.

"Generally cultivated only for feeding cattle." Vil.

Correctly figured in Les pl. pot., p. 184.

No. 42. LONG WHITE BUSH MARROW, VEG. GAR.; Vil.

Syn. *Long White Marrow Bush*, J. &. S., '86: Short Jointed Long White gourd or squash, Vil.: Fr., Courge blanche non coureuse, VIL.: C. de Virginie, Vil.: Ger., Langer Weisser Ohne Ranken Kürbiss, A. de Cl.: Weisse Kürbiss ohne Ranken, Vil.

Fruit long, comparatively slender, slightly swollen toward the blossom end, with five very narrow ribs, which are more prominent toward the stem; skin very smooth, white at full maturity; well developed samples 20 in. long, 4 in. in longest diameter; stem very short, very pale green, deeply furrowed, rapidly tapering; — plant not running, about 4 ft. in diameter, 2 ft. high; leaves deep green, with some grayish spots, very deeply 3 to 5 lobed, the lobes sometimes rather deeply cut, margin coarsely serrate, limb usually strongly dishing; petioles numerous, very pale green, scarcely channeled, with a very few short, stiff hairs; vine pale green, very short.

A summer squash, of which the fruits are used before maturity.

Correctly figured in Les pl. pot., p. 181; Veg. Gar., p. 262.

No. 43. MAMMOTH PUMPKIN, Sib., '87.

Fruit oblong oval, approaching cylindrical, the ends inclining to flat; obscurely ribbed, deep green, very finely mottled with whitish specks, very pale yellow where in contact with the soil; well developed samples 12 in. in diameter, 15 in. through the axis; skin rather soft;— flesh nearly white, thin, not firm, apparently very poor in quality;— plant vigorous; leaves very deep green, much spotted with grayish white, smooth; petioles rather short, channeled, the channels often blistered; sparsely hairy.

As grown at the Station, this variety appeared to have no value. It is possible, however, that the fruit failed to fully mature.

No. 44. ORANGE BUSH, Dam., '86.

The plant scarcely differs from that of Citron Bush, but the fruit is nearly round, with a broad depression at the blossom end; ribs marked about the stem, but obscure over the rest of the surface; skin rather rough, rich yellow, splashed with green; well developed samples 12 in. in diameter in both directions; stem short, furrowed, tapering rapidly, deep green.

No. 45. PATAGONIAN, Burr; Veg. Gar.; Vil., '84.

Syn. Fr., *Courge de Patagons*, Vil., '84: Ger., Patagonier schwarzgüner Kürbiss, A. de Cl.

Fruit oblong oval, with five very prominent, narrow, rounded ribs; skin deep, almost blackish green, not changing at maturity; well developed samples 15 in. long, 8 in. in diameter;— flesh pale yellow, inferior in quality; stem rather pale green, deeply furrowed, slightly tapering, set in a shallow cavity;— plant running, very vigorous; leaves, large, 3 or 5 lobed, clear green, with dentate margins; petioles long, rather slender, pale green, smooth, with rather numerous, green, stiff hairs; vine deep green toward the base, pale toward the extremities.

"Remarkable for its hardiness and productiveness."

Correctly figured in Les pl. pot., p. 183; Veg. Gar., p. 263.

No. 46. VEGETABLE MARROW, Burr (Credited to Thompson); Greg.; Hen.; Sib., '83; Thor., '87; Veg. Gar.; Vil., '85.

Syn. *Marrow Long White*, H. & S., '86: Succade Gourd, Burr: Fr., *Courge à la moelle*, Vil., '85: Moelle vegetale, Vil.: Suki blanc des Indes, Vil.: Ger., Englischer Schmeer-Kürbiss, Vil.: Flam., Mergpompoen, Vil.: Dan., Mandel-Groeskar, Vil.

Fruit oval or cylindrical, the five or ten more or less distinct ribs most marked toward the stem; skin very hard and tough at maturity; dull yellow or creamy white; well developed samples 12 in. long, 5 or 6 in. in diameter, often larger;— flesh white, tender and well flavored, particularly while the fruit is immature; stem deeply furrowed, tapering, deep green; — plant running, very vigorous; leaves medium, deeply 3, sometimes distinctly 5-lobed, clear green, often with ash-colored spots at the junction of the larger veins, limb rather strongly dishing, margin distinctly serrate, lobes sinuate on the margin, apex bluntly pointed, surmounted by a sharp projection; petioles slender, distinctly furrowed, very deep green toward the base, paler toward the extremity.

Very popular in England, where the fruits are used at all stages of growth after the blossom falls. The ripe fruit keeps well throughout the winter.

Correctly figured in Les pl. pot., p. 181; Veg. Gar., p. 261.

No. 47. WHITE PORTMANTEAU, Dam., '86.

Fruit very large; cylindrical, slightly swollen towards the blossom end; ribs very obscure; skin white, very smooth; well developed samples 26 in. long, 8 in. in diameter; stem rather slender, furrowed dark green; — plant running, vigorous; leaves often very large, roundish cordate, deep green, conspicuously marked with angular ash-colored spots at the junction of the veins, obscurely 3-lobed, apex and lobes bluntly pointed, margin very finely dentate or serrate; petioles rather slender, scarcely channeled, but often distinctly striped longitudinally with dark and pale green, hairs short, very numerous; vine rather slender angular, very deep green toward the base, with hairs like the petioles; flowers large on rather slender angular peduncles, calyx tube obscurely angular, sometimes extremely short, pale green, lobes very large, green, hairy, nearly erect, distinctly furrowed above.

B. Fruit stem broadly expanded at its union with the fruit.— *Cucurbita moschata.*

a. Fruits club-shaped or pyriform, the neck usually more or less crooked.

No. 48. CANADA CROOKNECK, GREG.; Thor., '83, '85, '87; VEG. GAR.; Vil.

Syn. Fall or Winter, gourd or squash, Vil.: Winter Gourd, Veg. Gar.: Fr., Courge coutors du Canada, VIL.: Ger., Canadischer Crook-neck Kürbiss, A. de Cl.

Fruit club-shaped, quite thick toward the blossom end, with a long, rather slender, solid neck, which is usually more or less curved; skin rather soft, yellow at full maturity, but dark green, often partly covered with a whitish bloom-like appearance before ripeness; well developed samples 10 to 12 in. long, 5 or 6 in. in largest diameter; —

flesh orange, thick, sweet, and when at its best, dry and well flavored, but often coarse and stringy; stem slender, tapering, much swollen at its union with the fruit, very deep green; — plant moderately vigorous; leaves very deep green, rather small, entire; petioles rather slender, tapering, obscurely channeled, the furrows often deeper green; vine more slender than the petioles, deep bluish green, with numerous white hairs.

A winter squash of good average quality, and an excellent keeper. It is said that in a few instances the fruit has kept into the second year after growing.

Correctly figured in Les pl. pot., p. 179; Veg. Gar., p. 260.

No. 49. CASHAW PUMPKIN, Thor., '87.

Fruit very thick club-shaped, sometimes inclined to curve, with a slight basin about the blossom end; obscurely ribbed; skin rather hard, dull pale yellow, finely mottled with a still paler tint; well developed samples 12 in. long, 7 in. in greatest diameter; — flesh pale yellow, solid except in the more swollen part near the blossom end; — plant moderately vigorous; leaves rather pale, dull green, with numerous whitish spots, large, obscurely 5-angled, surface smooth, considerably dishing, margin finely and distinctly serrate; petioles scarcely channeled, but striped with two shades of green, the older ones rather less hairy than the vine, which is nearly or quite round, pale green, striped in places with deeper green, densely covered with short white hairs.

Another CASHAW PUMPKIN, Land., '85, '87, bore fruit much the form of the Winter Crookneck squash, but larger in size, with numerous narrow, but not prominent ribs; skin rather soft, light cream color when ripe, pale green, with a whitish bloom when immature; — flesh salmon colored. The characters of the plant very closely resembled those of the above, with the exception that the vine was more vigorous. This is evidently the one described by Burr, who also mentions a third variety of which the fruit "is nearly round."

Both of the Cashaw pumpkins grown at the Station were very late, and would probably mature only in the most favorable seasons.

No. 50. WINTER CROOKNECK, BURR.

Syn. Cuckaw, Burr: *Large Winter Crookneck*, Greg., '87.

Fruit rather thick club-shaped, the neck usually curved, green or cream color when mature, though the color often changes after harvesting. "If green when plucked, it gradually becomes paler, or if yellow, it becomes a reddish cream color." Burr. Well developed samples 18 or 20 in. long, 6 in. in longest diameter; — "flesh salmon yellow, not uniform in texture or solidity, sometimes close-grained, sweet and fine flavored, and sometimes coarse, stringy and nearly worthless for the table." Burr. Plant vigorous; leaves deep green, often with whitish angular spots, rather distinctly angled, sometimes obscurely lobed; petioles channeled, the furrows darker green, less hairy than the vine, which is slender and very deep green.

A very hardy and productive variety. The fruit keeps remarkably well.

Correctly figured in Field and Garden Vegetables of America, p. 226.

b. Fruits oblong.

No. 51. EARLY NEAPOLITAN, Veg. Gar.; Vil., '84.

Syn. "*Early*," Dam., '86: Early Carpet-Bag Gourd, VEG. GAR.: Fr. *Courge portmanteau hâtive*, VIL., '84: Ger., Früher Mantelsack-Kürbiss, Vil.: Neapolitanischer Mantelsack-K., A. de Cl.

Fruit oblong, swollen toward the blossom end; obscurely ribbed; dull yellow when fully ripe; well developed samples 16 in. long, 5 in. in longest diameter; — flesh thick, solid and seedless except in the center of the swollen part, rich yellow, sweet and of excellent quality; — plant running, moderately vigorous; — leaves roundish cordate, inclining to pointed at apex, sometimes obscurely 3-lobed, deep, rather dull green, with veins and spots of whitish gray; petioles not much channeled, but rather distinctly striped with pale and deep green, with rather numerous short, stiff, white hairs; vine rather slender, very deep green, not furrowed, but obscurely angular, with very numerous long, slender white hairs.

The illustration of Courge pleine de Naples, Les pl. pot., p. 178; Veg. Gar., p. 259, would answer equally well for this variety, which is but an earlier form of it, differing only in size and season.

No. 42. ORANGE COLOR GIANT MELON, Dam., '86.

Fruit large; oval, ribs very obscure; rich orange; well developed samples 16 in. long, 10 in. in diameter; stem rather long, fleshy, not swollen at the center, pale green or yellowish, variegated and striped; — plant running, extremely vigorous; leaves "very large, roundish cordate, usually with a short, slender, protruding point, dull, slightly grayish green; petioles rather slender, channeled, with numerous short, white, hair-like prickles; vine much branched at the base, section nearly round.

NOTE.— The fruit of this variety appeared considerably mixed.

c. Fruits distinctly oblate.

No. 53. LARGE CHEESE PUMPKIN, Hen., '86.

Probably the Cheese pumpkin of Burr.

Fruit strongly oblate, with prominent ribs; skin smooth, moderately hard, yellow when ripe, before maturity mottled green, and covered with whitish bloom; well developed samples 10 to 12 in. in diameter, 5 to 6 in. through the axis ; stem slender, hairy; — plant vigorous; leaves large, entire or obscurely 3-lobed, deep green, with angular ash-colored spots; petioles pale green, scarcely channeled, with numerous short, stiff hairs; vine slender, angular, with the prickles more numerous and longer than on the petioles.

In a Large Cheese pumpkin from Thor., '87, the fruit was globular, or short pyriform, and of a pale, dull yellow, or buff color; but the characters of the plant correspond with the above.

No. 54. NIGGER PUMPKIN, Sib., '86.

Fruit strongly oblate, with numerous, but not prominent ribs ; rich orange; well developed samples 9 in. in diameter, 5 in. through the axis; blossom end depressed into a broad but shallow basin; stem deep green, little hairy, set in a broad, shallow, furrowed cavity; — plant vigorous, moderately prolific; leaves pale green, nearly entire; petioles pale green, little channeled, with a very few short hairs; vine deep green at the base, angular or slightly furrowed, nearly destitute of hairs.

No. 55. YOKOHAMA, GREG., '83; Vil., '87.

Syn. Yokohama Gourd, VEG. GAR.: Fr., *Courge de Yokohama*, Vil., '87; Ger., Japanesischer oder Yokohama Kürbiss, A. de Cl.

Fruit strongly oblate, with a basin about the stem and at the blossom end, quite irregular in form; distinctly and prominently ribbed and covered with small blister-like protuberances; skin hard, blackish green, the ends changing to light brown at complete maturity; well developed samples 10 in. in diameter, 5 in. through the axis; stem paler than either the fruit or vine, tapering; — flesh very thick, lemon color, fine grained and excellent; — plant vigorous, moderately productive; leaves very deep dull green, much spotted with white, entire, cordate, bluntly pointed at apex, younger leaves obscurely angled; petioles short, scarcely channeled, but sometimes striped with two shades of green, with rather numerous, short hairs; vine blackish green, furrowed. The fruit keeps well,

"After storing, it soon becomes entirely of a copper-like color, and is covered with a slight bloom. * * * The heaviest of all squashes in proportion to its size."

"Introduced into this country from Japan in the year 1860 by Mr. James Hogg." Greg.

Correctly figured in Les pl. pot., p. 180; Veg. Gar., p. 260.

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EGG-PLANT.

The varieties are few in number, and generally clearly defined. They are very readily separated into four classes by the color of the ripe fruits. The two scarlet varieties described are distinct from the others in having white flowers, as well as in the form of the fruits. They are also quite distinct from each other, each of them having been described as a separate botanical species.

Two of the classes may be sub-divided with reference to the form of the fruits.

The classification adopted is as follows:

1. Fruit purple.
    - A. Fruits roundish, or ovoid. Nos. 1–4, incl.
    - B. Fruits distinctly oblong. Nos. 5–7, incl.
2. Fruits (ripe) distinctly striped with purple and greenish yellow. No. 8.
3. Fruits white or cream colored.
    - A. Fruits roundish or ovoid. No. 9.
    - B. Fruits distinctly oblong. No. 10.
4. Fruits scarlet. Nos. 11–12.

DESCRIPTION OF THE VARIETIES.

1. Fruits purple.

A. Fruits roundish, or ovoid.

No. 1. BLACK PEKIN, BRILL; HEN., '83; Thor., '86; VEG. GAR.; Vil.

Syn. Fr., Aubergine noire de Pekin, Vil.: A. rond de Chine, VIL.: Ger., schwarze Pekin Eier-frucht, A. de Cl.

Fruit nearly spherical, glossy blackish purple, skin green where covered by the calyx lobes; well developed samples 6 in. in diameter;—plant 2 to 2½ ft. high; foliage rather dark purple, leaves large, nearly flat, margin coarsely but irregularly and roundly notched, borders nearly plain, leaves downy below; the younger ones purple on the under side; stem blackish, mottled with grayish specks; calyx blackish purple, very rough and somewhat spiny, the pointed divisions irregular in number.

A very popular variety. The fruit matures rather earlier than that of the New York Improved, and is considered superior to it in flavor. The plants are also more productive.

Correctly figured in Album de Clichés, Vil., No. 47,043.

No. 2. EARLY DWARF PURPLE, VEG. GAR.

Syn. *Early Round Violet*, Dam., '86: *Extra Early Dwarf Purple*, Thor., '83, '86: *Very Early Dwarf Purple*, Greg., '84, '85, '86: Fr., Aubergine violette naine très hâtive, VIL.: Ger., Violette sehr frühe Zwerg-Eierfrucht, A. de Cl.

Fruit small, obovate, dull, very dark purple, pale green where covered by the calyx; well developed samples 4 in. long, 2½ in. in diameter; flowers deep purple, peduncle swollen toward the fruit, and with the calyx on ripe fruit, has a slightly shriveled appearance; — plant low and branching; leaves slightly grayish green, elongated, thickly dotted on both sides with minute purplish specks, veins and petioles blackish purple, the latter sometimes slightly spiny.

The earliest variety extant, maturing its fruits three or four weeks before any other. The plants are remarkably productive, sometimes yielding a dozen fruits each, and their very dwarf habit makes them particularly adapted to frame culture.

Correctly figured in Les pl. pot., p. 26; Veg. Gar., p. 232.

No. 3. NEW YORK IMPROVED, BURR; HEN.; VEG. GAR.; Vil.

Syn. *Ferry's Improved Large Purple*, Fer., '83: *Monstrous of New York*, Dam., '86: New York Improved Large Purple, BRILL: *New York Improved Purple*, Hen., '85; H. & W., '85: *New York Improved Round Purple*, Greg., 86: *New York Purple*, Thor., '86; VEG. GAR.: Fr., Aubergine de New York, Seg. Gar.: A. monstreuse de New York, A. de Cl.: A. violette de New York, VIL.: Ger., Violette sehr grosse Amerikanische Eierfrucht, A. de Cl.

Resembles in general character the Round Purple, but the plant is more dwarf, of a more grayish green, and the fruit a shade paler in color. Fruit roundish, usually with a slight basin at the end opposite the stem, glossy purple, well developed samples about 6 in. in diameter in both directions; flesh nearly solid, the seed cavity very small; calyx pale green, scarcely spiny, irregularly cleft; — plant 12 to 15 in. high, compact, stocky, rather spreading, usually producing about 2 fruits; leaves numerous and large, nearly concealing the stem and fruit, flat, distinctly lobed, the younger ones with undulate borders; stem stocky, and with the petioles, ribs and veins very downy, destitute of spines, sometimes slightly inclining towards purple; — season intermediate.

The most popular variety in the New York market. Produced through selection from the Round Purple by Francis Brill, formerly of Jersey City, N. J.

Correctly figured in Album de Clichés, Vil., No. 47,041.

No. 4. ROUND PURPLE, BURR; Sib., '83; Thor., '86; VEG. GAR.

Syn. Fr., Aubergine violette ronde, VIL.

Fruit obovate, or short pyriform, slightly indented at the end opposite the stem; deep purple, sometimes a little streaked with yellowish green; well developed samples 5 in. in diameter, 6 in. through the axis; calyx and peduncle pale green, with rather numerous prickles; — plant dwarf, rather spreading, 12 to 18 in. high, and of equal diameter; leaves less large and less numerous than in the New York Improved; stem and branches glossy, much washed with purple towards their terminii; petioles, ribs and veins more or less tinged with purple; ribs of larger leaves often spiny, especially below; leaves nearly entire, the younger ones with undulate borders.

The plant is moderately productive, and medium or rather late in season.

Correctly figured in Les pl. pot., p, 25; Veg. Gar., p. 232.

B. Fruits distinctly oblong.

No. 5. LONG BLACK PURPLE PALERMO, Ben., '86.

Syn. *Long Dark Violet of Palermo*, Dam., '86; Ger., *Lange schwarzviolette von Palermo Eierpflanze*, Ben., '86.

Fruit large, long, obovate, rich brownish purple, slightly streaked and spotted in places with pale green; well developed samples 8 in. long, 4 in. in longest diameter; calyx pale green, deeply cleft, with two principal lobes, spiny; peduncle very large, striate, wrinkled; — plant vigorous, stocky, with immense nearly entire leaves; stem large, considerably branched, and with the petioles, ribs and veins faintly washed with purple; larger leaves nearly or quite a foot long, and 9 in. wide, midribs spiny both above and below; — season intermediate.

The fruit of this variety bears a considerable resemblance to that of the Long Purple, but the aspect of the plants is quite different.

No. 6. EARLY LONG PURPLE, Greg., '86; Hen., '85; VEG. GAR.; Vil.

Syn. Fr., Aubergine violette longue hâtive, VIL.

Fruit long obovate, sometimes a little club-shaped, usually somewhat curved, glossy, blackish purple; well developed samples 8 in.

long, 2½ in. in diameter; calyx green, usually formed of two principal segments, rough, wrinkled and with the peduncle somewhat spiny; — plant about 2 ft. high, branches rather few and spreading; leaves rather small, not numerous, giving the plant an open appearance that well exposes the fruit; petioles, ribs and veins sometimes purplish, downy but not spiny; the youngest leaves strongly washed with purple; stem blackish purple, with a very few inconspicuous spines, speckled with grayish toward the terminii of the branches.

An early and productive variety of good quality.

No. 7. LONG PURPLE, BURR; HEN.; Sib., '83; Thor., '86; VEG. GAR.; Vil.; WHITE.

Syn. Fr., Aubergine de Narbonne, Vil.: A. Violette longue, VIL.: Ger., Lange blaue Eierpflanze, Vil.: Lange violette Eierfrucht, A. de Cl.

Fruit oblong oval, somewhat club-shaped, very smooth, glossy, blackish purple, sometimes striped with green or yellow; well developed samples 7 in. long, 2½ in. in diameter; calyx brown, spiny; — plant about 2 ft. tall, green throughout except the very youngest leaves, which are often bordered with purple; leaves rather small, sinuate-lobed; stem glossy, little downy except toward the terminii of the branches, and with the petioles, ribs and veins pale green, sometimes inclining to brown; spines few.

Early, productive, hardy and reliable.

Correctly figured in Les pl. pot., p. 24; Veg. Gar., p. 231.

2. Fruits distinctly striped with purple and greenish yellow.

No. 8. STRIPED, VEG. GAR.; Vil.

Syn. Guadaloupe, Veg. Gar.: Guadeloupe, Vil.: *Guadeloupe Striped*, Bliss, '83; BURR: Striped Gaudeloupe, WHITE: *Striped Ornamental*, Thor., '86: Fr., Aubergine panachée de la Guadeloupe, VIL.: Ger., Gestreifte Riesen-Eierpflanze, Vil.

Fruit obovate, irregularly striped longitudinally, with pale purple on a greenish-white ground; well developed samples 3 in. in diameter, 5 in. through the axis; — plant dwarf, 12 to 18 in. high, green and free from spines throughout; leaves rather large, numerous, thick, nearly entire, the younger ones no more sinuate on the margins than the others; — season late.

Chiefly valued for its variegated fruits, which are quite ornamental.

3. Fruits white or cream-colored.

A. Fruits roundish or ovoid.

No. 9. WHITE, BURR; Thor., '83, '86; VEG. GAR.; Vil.; — *Solanum Ovigerum*, Dun.

Syn. *Round White*, Thor., '83: *White Giant of Naples ?*, Dam., '86: Fr., Aubergine blanche, VIL.: Œuf vegetal, Vil.: Plant aus œufs, Vil.: Pondeuse, Vil.

Fruit of the form and size of a turkey's egg, often somewhat larger; white or yellowish; — plant rather dwarf, considerably branched, green throughout, more or less spiny; leaves large, thick, margins sinuate, but not deeply lobed, younger leaves no more lobed than the older ones, but more undulate on the borders; stem slightly glossy, little downy; — season medium or rather late; plants very productive.

Grown only for ornament. The fruits are inferior in quality to those of the purple varieties, and have even been considered unwholesome.

Correctly figured in Les pl. pot., p. 27; Veg. Gar., p. 234.

B. Fruits distinctly oblong.

No. 10. CHINESE LONG WHITE, Burr.

Syn. Chinese Brinjal, VEG. GAR.; Vil.: *Long White China*, Greg., '83; White Fruited (d), HEN.: *White Long Chinese*, Vil., '83: Fr., *Aubergine blanche longue de Chine*, VIL., '83.

Fruit long oval, or cylindrical, usually curved, glossy white; well developed samples 8 in. long, $2\frac{1}{2}$ in. in longest diameter; — plant rather dwarf, pale green; fruit stems and petioles often slightly tinged with purple; margin of leaves sinuate; — season very late.

Not productive, but the fruit is said to be good when cooked; grown more for ornament or curiosity than as a vegetable.

4. Fruits scarlet.

No. 11. SCARLET FRUITED, Bliss, '83; BURR.

Syn. *Large Scarlet Red*, Dam., '86.

Fruit small, oval, distinctly ribbed longitudinally; bright scarlet, yellow just before maturity; little larger than a hen's egg; — plant very vigorous, with spreading branches; stem, petioles, ribs and veins yellowish green, downy, free from spines; leaves deeply lobed, borders of upper ones undulate; flowers small, pure white.

No. 12. TOMATO-SHAPED RED, Bliss, 83.

Syn. *Scarlet*, Greg., '86: *Scarlet Chinese*, Thor., '83: *Tomato Formed Red*, Ben., '83.

The fruit of this variety bears a striking resemblance both in form and color to that of the Tomato-shaped pepper; well developed samples 2 in. in diameter, 1 in. through the axis; — plant about 20 in. tall, rather compact in appearance; distinct through its thin, clear green, slightly shining, blistered, sharply lobed leaves; stem, petioles, ribs and veins purple, armed with long, very sharp spines; flowers small, white.

Like the Scarlet Fruited, this variety is very late, fruits sparingly, and is grown only for ornament.

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THE TOMATO.

[The tomatoes under present cultivation can all be referred to two species, *Lycopersicum pimpinellifolium* and *L. esculentum*, although authors have described the various forms or races under several names, which may be given in the form of synonymy.

LYCOPERSICUM PIMPINELLIFOLIUM.

Annual, stem herbaceous, smooth, weak; leaves quite equally pinnate, leaflets round ovate or cordate, quite entire; racemes simple, naked, long; fruit small, round, smooth, arranged in two ranks. Plant slender and diffuse, not odorous as the common tomato.

Solanum pimpinellifolium. Lin. sp., 1762, 265, Willd. sp., 1797, I, 1033 — Pers. syn., I, 226 — Mill. dict., 1807, n. 32.
Burnet-leaved tunato? Mawe's gard. dict., 1778.
Solanum pimpinellinum, L. (sic). Lam., enc. meth., 1797, IV, 286.
Lycopersicum pimpinellifolium. Dun. sol., 1813, 111.
Grape or Cluster tomato. Burr, veg. of Am., 1863, 646.
Tomato groseille. Vilm., les pl. pot., 1883, 560, fig.
Currant tomato of American seedsmen.

The habitat of this species is given as Peru by Linnæus, Willdenow, Persoon and Miller, and as Peru and Brasil by Dunal. The plant is extremely hardy, vigorous and prolific, the long racemes often containing twenty or more clear, bright red fruits somewhat larger than a very large currant.

LYCOPERSICUM ESCULENTUM.

Annual. Stem herbaceous, hairy, glandular; leaves unequally and interruptedly 1-2 pinnate; leaflets more or less incised and toothed, varying much in varieties, often entire; calyx lobes of variable length in relation to the corolla; flowers often coalescent; fruit 2-many celled, globose, depressed and angular, or elongated; and red, yellow or white in color. Plant weak and decumbent, sub-erect, or occasionally erect.

Var. a. *Cerasiforme.* Stem weak; calyx little, shorter than the corolla; berry globose, small or of medium size, neither ribbed nor angular, borne in clusters, normally 2-celled, red or yellow. Flowers scarcely ever coalescing.

This variety or race has been described under the following names:

1. The red fruited:
   Solanum racemosum cerasorum forma. Bauh. prod., 1620; pin., 1623, 167 — Sloane cat., 1696, 109.
   S. racemosum cerasorum forma C. Bauhini. J. Bauh., 1650, 3, 623.
   Pomum amoris, cujus fructus colore, magnitudine, etc., plane similis erat Strychnodendros. Hernand., 1651, 296, note.
   S. pomiferum fructu rotundo, parvo molli, rubro plano. Mor. hort., bles., 1669, 310 — Mor. ox., 1699, 3, 521 — Rai hist., 1704, supl., 3, 352 — Tourn. inst., 1719, 150 — Tilli. cat. pisan., 1723, 106.
   S. pomiferum, fructu rubro minore. Weinm. phyt., 1745, t. 935, fig. d.
   S. lycopersicum, var. b. Lin. sp., 1762, 265.
   Lycopersicum cerasiforme. Dun. sol., 1813, 113.
   Lycopersicum esculentum, Mill. var. cerasiforme. Gray, syn. fl. 2, 226.
   Red Cherry of American gardens.
2. The yellow fruited:
   Solanum pomiferum fructu rotundo, parvo, molli, luteo, plano. Mor. hort. bles., 1669, 310.

Lycopersicon fructu cerasi, luteo. Tourn. inst., 1719, 150.
S. pomiferum seu Poma amoris fructu luteo minore. Weinm. phyt., 1745, t. 935, fig. c.
Yellow Cherry of American gardens.

This form is spontaneous in the southern borders of Texas (Gray), and I have seen escapes in New Jersey. It is recorded as wild in Jamaica by Sloane and by Lunan, and is said by Dunal to be a native of Peru. It has retained its identity throughout its recorded culture, so far as can be determined by pictures, and seems to have attained to varieties with larger fruit under the conditions induced by culture. The leading character is the globular form of the fruit, and not the size.

Var. b. *Vulgare.* Leafless incised; flowers often coalescent; berry depressed, angular or ribbed, 3-many celled.

Poma amoris, an Glaucium Diosc., Lycopersican quorundum. Lob. obs., 1576, 140, ic.
Pomum amoris sive de oro. Cam. hort., 1588, 130.
Poma amoris. Bassæus ic., 1590, 785—Tab., 1591, 464, ic.; 1613, 493, ic.
Poma amoris, Pomum aureum, Lycopersicum. An Glaucium Diosc. Lob. ic., 1591, 270.
Poma amoris majora. Hernand., 1651, 296.
Poma amoris. Swertius flor., 1654, t. 20.
Solanum lycopersican. Lin. sp., 1762, 265—Willd. sp., 1797, 1, 1033—Lam. enc. meth., 1797, 4, 287; ill. gen., t. 115, fig. 2—St. Hil., exp. des fam. nat., 1805, 1, 290—Mill. dict., 1807, n. 33—DeC. fl. fran., 1815, 3, 614—Thunb. cap., 1825, 188—Mayc. barb., 1830, 98.
Tomate. Long, jam., 1774, 3, 773.
Lycopersicum esculentum. Dun. sol., 1813, 111—Bojer maurit., 1837, 241—Don. gard. dict., 1838, 4, 443.

1. The fruit red or purplish:

Mala aurea (rubrum). Matth., 1558, 479; 1570, 684.
Poma amoris, etc. (purpureus). Pena & Lobel, adv., 1570, 108.
Aurea mala (rubeus). Dod. pempt., 1583, 454, ic., 455; 1616, 457, ic., 458.
Amorous Apples (red). Lyte's dod., 1586, 508.
Poma amoris, Poma aurea (rubra). Cam. ep., 1586, 821, ic.
Poma aurea (rubrum). Lugd., 1587, 1, 628.
Solanum pomiferum fructu rotundo, striato, molli (rubeus). Bauh. phytopin., 1596, 302—Bauh. pin., 1623, 167—Mor. bles., 1669, 195—Rai hist., 1686, 1, 675.
Poma amoris, Apples of Love (red). Ger., 1597, 275, fig.
Solanum pomiferum, fructu rotundo, molli (rubrum). Matth., 1598, 760, ic., 761—Mor. ox., 1699, 3, 520, s. 13, t. 1, f. 7.
Pomum amoris fructu rubro. Eyst., 1613, aut. ord. 1, f. 2.
Pomi d'oro (rosse come sangue). Cast. Dur., 1617, 372, ic.
Mala aurea odore fœtido, quibusdam Lycopersicon (purpurascens). J. B., 1650, 3, 620, ic.
Tomatl (rubrum). Hernand., 1651, 295.
Mala aurea (purpurascens). Chabr., 1677, 525, ic.
Pomum amoris majus fructu rubro. Rai hist., 1688, ap. 2, 1877.

Lycopersicon fructu e rubro pallescente. Tourn., 1719, 150, t. 63.
Lycopersicon Galeni. Morand, 1744, 107, t. 53, f. 8—Tourn., 1719, 150.
Solanum pomiferum fructu rubro majus. Weinm. phyt., 1745, t. 935, f. b.
Pomum amoris, Solanum pomiferum, Lycopersicon (rubrum). Blackw., 1750, t. 133.
Solanum lycopersicum (red). Bryant, fl. diet., 1783, 212.
Morelle pomme d'amour. Descourt. fl. ant., 1827, 6, 95, t. 405.

2. The fruit yellow or orange:

Mala aurea (aureum). Matth., 1558, 479.
Poma amoris, etc. (fulvus). Pena & Lob., adv., 1570, 108.
Aurea mala (aureum luteum). Dod. pempt., 1583, 454, ic., 455; 1616, 457, ic., 458.
Amorus Apples (yellowe). Lyte's dod., 1586, 508.
Poma amoris. Poma aurea (crocea). Cam. ep., 1586, 821, ic.
Poma aurea (aureum). Lugd., 1587, 1, 628.
Solanum pomiferium fructu rotundo, striata, molli (luteum aureum). Bauh. phytopin., 1596, 302—(lutens). Bauh. pin., 1623, 167—(auricolor), Bauh. pin., 1623, 167.
Poma amoris, Apples of Love (yellowe). Ger., 1597, 275, fig.
Solanum pomiferum, fructu rotundo, molli (aureum). Matth., 1598, 760, ic., 761.
Pomum amoris fructu luteo. Eyst., 1613, aut. ord. 1, f. 1.
Pomi d'oro (d'oro). Cast. Dur., 1617, 372, ic.
Mala aurea odore fœtido, quibusdam lycopersicon (ochræum). J. B., 1650, 3, 620, ic.—(aureo), J. B., 1650, 620, ic.
Tomatl, (luteum). Hernand., 1651, 295.
Solanum pomum amoris fructu striato molli aureo. Mor. bles, 1669, 195, 311.
Mala aurea (ochreus). Chabr., 1677, 525, ic.—(aureum), Chabr., 1677, 525, ic.
Pomum amoris majus fructu luteo. Rai hist., 1688, ap. 2, 1879—(aureo) Rai hist., 1688, ap. 2, 1877.
Solanum pomiferum seu Poma amoris fructu striato and sulcata aureo. Mor. ox., 1699, 3, 521, s. 13, t. 1, f. 7.
Solanum pomiferum fructu striato and sulcato aureo. Ray hist., 1704, 3, 352.
Lycopersicum fructu luteo. Tourn., 1719, 150—Tilli. pis., 1723, 106.
Solanum seu Poma amoris fructu luteo. Weinm. phyt., 1745, t. 935, f. c.
Pomum amoris, etc. (luteo). Blackw., 1750, t. 133.
Solanum lycopersicum (deep orange). Bryant, fl. diet., 1783, 212.

3. The fruit white:

Solanum pomiferum fructu rotundo striato molli (albus). Bauh. pin., 1623, 167.
Pomum amoris majus fructu albo. Rai hist., 1688, ap. 2, 1877.
Lycopersicon fructu albo. Tourn., 1719, 150—Tilli. pis., 1723, 106.
Pomum amoris, etc. (albidum). Blackw., 1750, t. 133.
Solanum lycopersicum. Lour. coch., 1790, 130.

4. The fruit versicolored:

Mala aurea odore fœtido quibusdam lycopersicon (versicolor). J. B., 1650, 3, 620. Mala aurea (versicolor). Chab., 1677, 425, ic.

5. Stems variegated.

Amoris pomum II. Blackw., 1750, t. 133.

Dunal, the authority on this subject, gives the habitat as the warmer portions of America, but doubtfully. The species is recorded as growing wild in Cochin China by Loureiro, at the Cape of Good Hope by Thunberg, at the Mauritius by Bojer, and in Central Africa by Grant. It is an American plant and was grown in tropical America in improved varieties at the time of the discovery, for many of the earlier figures in our references exhibit fruit of a form as highly improved as those existing under present culture. For the history of its use in America, see the American Naturalist for July, 1885.

The principal characters are the depressed fruit; these fruits, always more or less angular, may be quite even or ribbed on the same plant. There has been little improvement in form gained within recent times, as the figures in our references quite clearly indicate. That we have gained in flavor, prolificacy and earliness may be claimed, as such claims are difficult to disprove, and represent changes very probably within our power.

Sub-var. *grandifolium.* Leaves very large, 1-pinnate; leaflets few, and entire. The leaves of very young plants entire.

Tomate macrophyllum. Damman & Co. cat., 1884, fig.

Lycopersicum esculentum, var. grandifolium. Bailey, am. nat., June 1887, 576.

Potato Leaf, N. Y. Sta., 1886.

Mikado, N. Y. Sta., 1886.

This section represents plants which have but recently appeared under cultivation. Keyes' Early Prolific, grown by us in 1883, is the first of this class we had seen. In character of fruit, allied to our var. b, but the leaf habit very distinct, and suggesting specific differences.

Sub-var. *validum.* Erect; stem very thick and stout; leaves dark green, short, dense; leaflets wrinkled and recurved.

Tomate à tige raide de Laye. Vil. les pl. pot., 1883, 557, fig. 558.

Station. N. Y. Agr. Exp. Sta. Rept., 1886, 172, fig. p. 173.

Lycopersicum esculentum, var. validum. Bailey, Am. nat. l. c.

Var. c. *Oblongum.* Fruit oblong, or longer through the axis than through the diameter, frequently pear-shaped, fig-shaped, or plum-shaped; 2-celled; color red or yellow.

Solanum pomiferum. Pers. syn., 1805, 1, 226 — Poir. supl., 1813, 3, 759.

Lycopersicum pyriforme. Dun. sol., 1813, 112 — Don. gard. dict., 1838, 4, 443.

Pear-shaped. Hort. trans., 1819, 3, 347.

This form is not recorded as wild, but is noted by Dunal and others as cultivated in botanic gardens. Red and yellow varieties were in American gardens preceding 1848.

We add to this list the following whose characters, as given, scarcely justify specify rank:

Lycopersicum Humboldtii.

Stem herbaceous, hairy; leaves unequally pinnate, hairy; leaflets incised, glaucescent beneath, the lobes of the calyx but half as long as those of the corolla.

Very like L. cerasiforme, but differs in the racemes and flowers being smaller, the berries also smaller and red, in the wild plant but about half the size of those under cultivation. Dun. sol., 112.

The berry is 2-3 celled, smoothish, and when cultivated not less angular than those of L. esculentum, ex Nees. Don, gard. dict., IV, 443.

Lycopersicum Humboldtii. Dun. sol., 1813, 112 — Kunth, syn., 1823, 2, 157.
Solanum Humboldtii. Poir. sup., 1813, 3, 759.
Tomato of the island of Cura. Humboldt, trav., Bohn ed., 1852, 2, 20.

This species is found wild in the region of the Rio Negro, South America (Dunal), and is cultivated in the province of Caracas, Venezuela (Kunth), and everywhere in the valleys of Aragua (Humb.). It was grown in Europe in 1822 (Don.)

I suspect the Turban tomato or Turk's Cap to be but a monstrous variety of this species, and that this species may be the original of some of the varieties of the L. esculentum, or cultivated tomato, but far more study must be given before this conclusion can be warranted.]

E. L. S.

Many of the cultivated varieties of the tomato are quite difficult of accurate description owing to the variability in the form and time of ripening of the fruit, and to the want of variety characters in the foliage. Horticultural works furnish little assistance, as comparatively few varieties have been described at all, and the descriptions of these are for the most part quite meager. Almost all of the varieties at present grown in this country are of American origin, and have been introduced within the past quarter of a century.

Several of the varieties of more recent introduction bear a very close resemblance to each other, differing only in such characters as firmness of the flesh, the proportion of seed yielded, etc. As these characters have an economic importance, they cannot be ignored. In this article such distinctions have been recognized wherever they clearly exist.

EXPLANATION OF TERMS.

In respect to size, a fruit measuring more than four inches in transverse diameter is called *very large;* one three to four inches in diameter is called *large;* one two and a half to three inches, *medium*, and one two to two and a half inches in diameter, *small.* Fruits of less diameter than two inches are called *very small.*

In respect to form, the fruit is called *oblate* when its transverse diameter exceeds its axial diameter; *spherical* when the two diameters are about equal, and *oval* when the axial exceeds the transverse diameter. It is said to be *hemispherical* when the contour of a section through the axis approaches a semi-circle, and *pyriform* when it is pear-shaped.

The *outline* of the fruit means the contour of a transverse section through its center. The outline is said to be *angular* when the contour is distorted in obscure angles, and *corrugated* when it bends into scallops or folds. It is *regular* when it exhibits neither angles nor corrugations, but approaches a circle.

The *cavity* and *basin* have the same significance as in pomology, *i. e.*, the former representing the depression about the stem, and the latter in the opposite part of the fruit. The basin is said to be *ringed* when it is bounded by a more or less distinct and regular corky ring, and *fissured* when it contains distinct irregular depressions reaching nearly or quite to the center of the fruit.

The center of the fruit is said to be *well filled* when the cells are chiefly disposed about the outside, leaving the center largely occupied with the pulp.

The terms applied to the foliage are used in their strict botanical sense.

The flavor of the fruit is not often specified, as I have been able to detect little difference in this respect except as between fruits of different color. The fruits of the white and yellow varieties are less acid than those of the scarlet ones, and those of the purplish red tint are in general rather harsher in taste than those of other shades. But with a very few exceptions, other differences have not seemed sufficiently marked for specification.

ANALYTICAL KEY.

As an aid in naming varieties, the following analytical key is arranged:

1. Plant strongly scented, stem hairy, leaves unequally one to two pinnate *(Lycopersicum esculentum)*.
    - A. Stem weak; plant decumbent.
        - a. Leaflets numerous, toothed, more or less pinnate *(var. vulgare)*.
            - *. Fruit more than two-celled, with a more or less distinct cavity about the stem.
                - ‡. Fruit deep scarlet.
                    - §. Outline angular or corrugated. Nos. 1–24, incl.

§§. Outline regular or nearly so. Nos. 25–27, incl.

‡‡. Fruit purplish red.

§. Outline angular or corrugated. Nos. 38–39.

§§. Outline regular or nearly so. Nos. 40–45, incl.

‡‡‡. Fruit yellow or orange.

§. Outline angular or corrugated. Nos. 46–48, incl.

§§. Outline regular or nearly so. Nos. 49–51, incl.

‡‡‡‡. Fruit whitish. No. 52.

**. Fruit two (sometimes three) celled, without a cavity about the stem.

†. Fruit spherical *(var. cerasiforme).*

‡. Fruit deep scarlet. No. 53.

‡‡‡. Fruit yellow. No. 54.

††. Fruit oval or pyriform (var. *oblongum*).

‡. Fruit deep scarlet. Nos. 55–57, incl.

‡‡‡. Fruit yellow. Nos. 58–59.

b. Leaflets few and very large, never pinnate, nearly or quite entire. (Sub–var. *grandifolium).*

‡. Fruit deep scarlet.

§. Outline angular or corrugated. No. 60.

‡‡. Fruit purplish red.

§. Outline angular or corrugated. No. 61.

§§. Outline regular. No. 62.

B. Stem stocky, plant erect or nearly so. (Sub–var. *validum).*

‡. Fruit deep scarlet.

§. Fruit angular or corrugated. No. 63.

§§. Fruit regular or nearly so. No. 64.

2. Fruit not strongly scented, stem smooth, leaflets entire *(Lycopersicum pimpinellifolium).*

‡. Fruit deep scarlet. No. 65.

DESCRIPTION OF THE VARIETIES.

1. Plant strongly scented, stem hairy, leaves unequally one to two pinnate. — *(Lycopersicum esculentum.)*

A. Stem weak, plant decumbent.

a. Leaflets numerous, toothed, more or less pinnate, (var. vulgare).

***. Fruit more than two-celled, with a more or less distinct cavity about the stem.**

‡. Fruit deep scarlet.

§. Outline angular or corrugated.

No. 1. ALPHA, Thor., '83, '87.

Fruit medium to large; strongly oblate, the more regular samples inclining to hemispherical; outline almost always more or less angular and often corrugated; cavity medium or shallow, furrowed; basin small or wanting in the well-formed fruits, with a russet spot at the center, usually more or less ringed and fissured in the larger fruits; cells 6 to many; flesh moderately firm; — plant rather feeble; calyx segments a little more than half as long as the corolla ; — season early.

No. 2. ARLINGTON, Greg., '83, '87.

Fruit medium to very large; strongly oblate; outline usually more or less angular, often corrugated; cavity medium, deeply furrowed; basin sometimes almost wanting in the smaller fruits, being marked only by a very small fissure surrounded by a small russet ring; in the larger fruits the basin is often very irregular; cells 5 to many, small; flesh very thick and firm; — plant very vigorous; — foliage rather pale green, leaflets rather broad; calyx segments a little shorter than the corolla; — season rather late.

No. 3. BERMUDA, Land., '87. (Not of BURR.)

Syn. *Extra Early or Cluster*, Land., '87.

Fruit medium to large; oblate; outline extremely irregular, angular in the smaller and deeply corrugated in the larger fruits; cavity shallow, deeply furrowed in the larger fruits; basin wanting in all except the largest samples, in which it is fissured, but without a defined ring; cells numerous and very large; flesh thin, remarkably soft; — plant moderately vigorous; leaves deep green, somewhat shriveled, seldom 2-pinnate; calyx segments about equal in length to the corolla.

A very early variety, but quite worthless when better sorts are obtainable.

No. 4. BLOUNT'S CHAMPION CLUSTER, Thor., '83.

The fruit resembles that of the Trophy, and is borne in clusters of 2 to 5; leaflets somewhat broader than those of the Trophy; — season medium.

No. 5. BOSTON MARKET, Greg., '83, '85, '87.

Syn. *Fulton Market* (incorrectly), Till., '85.

Fruits a little less oblate, and slightly more regular than those of Alpha, maturing also a trifle later, but scarcely differing in other respects.

No. 6. BRONZE FOLIAGE TROPHY, Thor., '86.

Syn. *New Bronze-Leaved*, Greg., '87.

Scarcely distinct from the Trophy with the exception that the foliage is of a very peculiar deep bronze green. The fruit, like that of the Trophy, is of excellent quality, but rarely regular in form. It ripened somewhat earlier than that of the Trophy.

No. 7. BUNKER HILL, Bliss, '87.

Resembles Great Chihuahua, but the foliage is paler, the fruit averages a trifle smaller, slightly less corrugated, and matures very much earlier, being one of the earlier varieties; flesh thin, moderately firm, ripens unevenly; of no value as compared with the many superior varieties.

No. 8. EARLY JERSEY, Land., '87.

Resembles the Trophy, but the fruit is smaller, somewhat less corrugated, and ripens considerably earlier. The skin is often roughened about the stem, both in the green and ripe fruit, with shallow circular cracks.

It was recommended as being first early, but did not prove so at the Station.

No. 9. FAULTLESS, Greg., '87.

Closely resembles the Conqueror, but the fruit is less oblate, more regular in outline, and not quite so early in ripening.

No. 10. FULTON MARKET, Greg., '87.

The fruit is scarcely distinguishable from that of General Grant, but the foliage differs in having the leaflets broader, less closely set, and rather less deeply cut. The calyx segments are also rather shorter as compared with the corolla. In season, the two are about the same.

No. 11. GEN. GRANT, BRILL; HEN.; Sib., '83; Vick, '87.

Syn. *Conqueror*, Sib., '83; Thor., '87: *Early Conqueror*, Fer., '83.

Fruit medium, occasionally large, often considerably splashed with bronze; rather strongly oblate; outline usually angular, and sometimes corrugated; cavity medium, usually slightly furrowed; basin not much hollowed, sometimes fissured, and occasionally very irregular, but never clearly ringed; cells 6 to many, usually small; flesh rather thick, but quite soft; — plant feeble, leaves usually twice-pinnate in the lower half; leaflets narrow, rather closely set and deeply cut, much shriveled; calyx segments about equal in length to the corolla; — season early.

No. 12. GIANT OF SMYRNA, Dam., '86.

Fruit small to very small, oblate; outline corrugated; cells numerous; flesh soft; plant moderately vigorous; leaflets rather small; — season medium.

Of no value for this climate.

No. 13. GOOSEBERRY FRUITED, H. & S., '86.

Similar to the Giant of Smyrna; fruit a little larger, and more corrugated; flesh very soft; — plant very feeble, foliage much shriveled.

Of no value for this climate.

No. 14. GREAT CHIHUAHUA, Greg., '83.

Syn. *Mexican Mammoth*, S. E. Mitchel, '85: *President Garfield*, Sib. '83, '87. Probably the Giant (Syn. Mammoth) of BURR.

Fruit of the largest size, sometimes 5 in. in diameter; strongly oblate; outline deeply corrugated; cavity broad, much furrowed; basin exhibiting every shade of deformity; cells very numerous, usually small; flesh thick, center usually well filled; sometimes a secondary series of cells is formed at the center; — plant very vigorous, leaves largely 2-pinnate; calyx lobes nearly or quite as long as the corolla; — season late.

No. 15. HOWARD, Greg., '83.

Closely resembles the Arlington, but produces more small fruits; in season the two are the same.

No. 16. HUBBARD'S CURLED LEAF, Sib., '83; Vick, '87.

Syn. *Early York*, Greg., '83: *Dwarf Striped Japanese*, Ben., '86: *San Salvador* ?, Dam., '86: Fr., *Tomate du Japan naine striée*, Ben., '86.

Fruit medium to small; strongly oblate; outline always more or less angular, often deeply corrugated; cavity medium, often very deeply furrowed; basin wanting; in the smaller fruits the center is marked by a very small spot, in the larger ones it is often very irregular; cells 4 to many, often not filled by the seeds; flesh thick, soft, center not well filled; — plant not vigorous, very spreading, foliage much shriveled; older leaves often twice-pinnate in the lower half; leaflets not much cut, segments rather rounded than pointed; calyx segments nearly or quite as long as corolla.

One of the earliest varieties, but aside from this is without merit.

No. 17. HUNDRED DAY, Thor., '83, '87.

Resembles Hubbard's Curled Leaf, but the fruit averages rather smaller; the plant is decidedly less vigorous, and the leaflets narrower and more closely set; very strongly shriveled, and late in the season much blighted; calyx segments half to three-fourths as long as the corolla. Like the Hubbard's Curled Leaf, it has no merit except its great earliness.

No. 18. ORANGEFIELD, Greg., '83.

Syn. *Dwarf Orangefield,* Sib., '87.

Fruit small, averaging about 2 in. in diameter; roundish or slightly oblate, sometimes inclining to conic; outline somewhat angular, the surface presenting 2 or 3 rather obscure longitudinal furrows, corresponding to the number of cells; cavity very slight, scarcely furrowed; basin wanting; flesh thick, moderately firm; — plant very vigorous, leaves usually 2-pinnate; segments of leaflets very bluntly pointed; calyx segments as long as corolla; — season medium.

The fruit detaches very easily, with the calyx and a short section of the stem.

No. 19. PRECURSOR, B. M. & CO., '84.

Syn. *Early Richmond,* Land., '85, '87.

Fruit medium to large; rather strongly oblate; outline angular, often corrugated; cavity deeply furrowed; basin usually very slight, the center often marked by a mere russet spot; in the larger fruits ringed, fissured, and often extremely irregular; cells 5 or 6, sometimes many, rather large; flesh moderately firm, the center not well filled; — plant not vigorous; foliage dull, slightly grayish green; leaves often 2-pinnate in the lower half, calyx lobes as long as corolla.

Early, but otherwise without merit.

No. 20. QUEEN, Hen., '84.

Syn. *Improved Queen,* Thor., '86, '87: *Red Valencia Cluster,* Thor., '83.

Fruit uniformly large; strongly oblate; outline usually angular, and often much corrugated; cavity deep, but narrow, more or less, often deeply furrowed; basin sometimes wanting, the center marked only by a russet spot, often ringed and fissured; cells numerous, small; flesh thick, rather firm, center well filled; — plant vigorous; leaves often 2-pinnate in the lower half, calyx segments as long as the corolla; — season medium.

Another Queen tomato, Fer., '84, Hen., '87, was quite distinct from the above, having the fruit very regular, closely resembling that of Livingston's Favorite, with rather light green foliage and broad leaflets.

No. 21. SANTA CATERINA, H. & S., '86.

Resembles the Great Chihuahua, but the fruit is not quite so large; extremely corrugated.

No 22. TRIUMPH, Greg., '83.

Syn. *Island Beauty,* Hen., '87: *Large Smooth Red,* Thor., '87: *Reade's Island Beauty,* Thor., '83.

Fruit medium to large; strongly oblate; outline very irregular, often much corrugated; cavity broad, often very deeply furrowed; basin shallow and broad, with a rather large russet spot at the center in the more regular fruits, often much distorted and fissured, but rarely ringed; cells numerous, usually small; flesh rather soft, center well filled; — plant not very vigorous, leaves almost always 2-pinnate in the lower half; leaflets rather deeply cut, often much shriveled; calyx segments nearly or quite as long as the corolla; — season medium.

No 23. TROPHY, Brill; Hen., '83, '86; Thor., 87; Vil.

Syn. Large Red Smooth Trophy, A. de Cl.: Fr., Tomate rouge grosse lisse, VIL.: Ger., Rothe grossfrüchtige glattschalige Tomate, A. de Cl.

Fruit large to very large; rich scarlet; strongly oblate; outline more or less often very irregular, often much corrugated; cavity shallow, distinctly furrowed; basin rarely regular, exhibiting all shades of deformity in the larger fruits; cells numerous, usually small; flesh thick, rather firm, center very well filled; — plant vigorous; leaves usually 2-pinnate in the lower half; flowers large, often abortive; calyx lobes nearly or quite as long as corolla; — season rather late.

Formerly very popular, and still quite largely grown. Its tendency to irregularity in the fruit is its chief fault.

No. 24. TURK'S CAP,? '82.

Syn. *Turban,* ? '82; Fr., Tomate Bonnet turc, Vil.: Ger., Scharlachrother Turkenbund Tomate, Vil.

Fruit small, produced in clusters of ten to fifteen; somewhat oblate, but with a peculiar protuberance in the part opposite to the stem, caused by an abnormal development of a part of the carpels; outline more or less angular, sometimes somewhat corrugated; cavity small, distinctly furrowed; — plant remarkably vigorous and productive; — season very early.

Of no value either for the table or market.

Correctly figured in Gregory's catalogue of 1882.

§ §. Outline regular or nearly so.

No. 25. AUTOCRAT, Sib., '86, '87.

The fruit averages a little smaller than that of Livingston's Perfection; otherwise the two appear identical.

No. 26. CARDINAL, Greg., 84; Thor., '87.

Syn. *Burpee's Cardinal,* Burpee, '86.

Fruit scarcely distinct from that of Livingston's Perfection, except in yielding fewer seeds.

No. 27. COOK'S FAVORITE, BRILL; Greg., '83.

Very similar to the Little Gem, with the exception that the fruits average one-half larger. In season and qualities they are the same.

Another Cook's Favorite, Land., '87, was entirely distinct from the above, the fruits being medium to large, and very regular. The stock was mixed, however, some plants bearing scarlet and others purplish red fruits.

No. 28. EARLY ADVANCE, Thor., '87.

Syn. *Essex Round Red Smooth,* Greg., '85, '87: *Large Round Red Smooth.* Greg., '87.

Fruit small to medium; oblate, inclining to hemispherical; cavity shallow, scarcely furrowed; basin wanting, the center marked by a russet spot of variable size and form; cells 3 to 8; flesh moderately firm, ripening very evenly; — plant vigorous; leaves rather largely 2-pinnate; calyx segments rather shorter than corolla; season early.

No. 29. EARLY SMOOTH RED, Vick., '87.

Syn. *Early Red Smooth,* Thor., '83: *Early Round Red Smooth,* Greg., '83: *Extra Early Red,* Sib., '83: *Extra Early Trophy,* J. & S., '86: — Probably the White's Extra Early (Syn. Early Red, Extra Early) of BURR.

Fruit medium to small, produced in clusters of 3 to 5; oblate; outline rather regular; cavity shallow, very slightly furrowed; basin wanting, the center marked by a small dot; cells usually 3 or 4 large; flesh rather soft, center not well filled; — plant moderately vigorous; foliage usually more or less shriveled; calyx segments rather shorter than corolla.

A very early variety, but too soft for market purposes.

No. 30. HATHAWAY'S EXCELSIOR, Sib., '83; Veg. Gar.; Vick, '87; Vil.

Syn. Apple-Shaped Red, VEG GAR.: Large Smooth, Vil.: Fr., Tomate pomme rouge, VIL.

Fruit medium to small, produced in clusters of two to six; slightly oblate, inclining to hemispherical; cavity very small, or wanting, usually not furrowed; basin wanting; cells 3 to 5, medium to large; flesh thick, very firm, center not very well filled; — plant vigorous, leaves seldom 2-pinnate; calyx segments rather shorter than corolla; — season early.

No. 31. LITTLE GEM, Greg., 87; Thor., 83.

Fruit very small, larger ones about 2 in. in diameter; slightly oblate; cavity very slight, not furrowed; basin none, in the smaller fruits, the center marked only by a small spot; in the larger ones it is ringed and fissured; cells 6 to 8, very small; flesh rather thin, remarkably firm, center very well filled; — plant feeble, leaves 2-pinnate in the lower half; leaflets narrow, considerably shriveled, closely set; deeply cut; calyx lobes $\frac{1}{2}$ to $\frac{3}{4}$ as long as corolla; — season very early.

No. 32. LIVINGSTON'S FAVORITE, Greg., 83; Land., 84, '85; Liv., '86, '87; Thor., '87.

Syn. *New Jersey*, Thor., '87: *Optimus*, Fer., '85; Thor., '87: *The Favorite*, Greg., '85.

Closely resembles Livingston's Perfection, differing from it in the fruit being somewhat less oblate, better filled at the center, and in producing less seed. In season it is about the same, though it is said to ripen more of its fruit early.

One of the most popular of all varieties for table use and market, and it is said to be especially valuable for canning.

Introduced by Mr. A. W. Livingston, of Des Moines, Ia.

No. 33. LIVINGSTON'S PERFECTION, Sib., '83; Liv., '87; Thor., '87.

Syn. *Market Champion ?*, J. & S., '86: *Perfection*, Hen., '84.

Fruit medium to very large; oblate, but inclining to hemispherical; outline almost always regular, the largest samples sometimes a little angular; cavity small, sometimes obscurely but never distinctly furrowed; basin wanting, the center marked by a small russet spot; cells 5 to many, often rather large; flesh thick, rather firm, usually well filled at the center; — plant very vigorous; leaves 2-pinnate in the lower half; leaflets rather remote and deeply cut; calyx lobes nearly or quite as long as the corolla; — season medium.

An excellent variety either for the table or market.

Introduced by A. W. Livingston, of Des Moines, Ia.

No. 34. MAYFLOWER, ?, '82; Vick, '87.

Syn. *Emery*, Farq., '85. *Improved Mayflower*, D. of A., '87: *Rawson's Puritan*, Raw., '87.

Scarcely distinct from Livingston's Favorite. The only difference noticed was that the fruits averaged very slightly smaller.

Introduced in 1882 by F. H. Horsford, of Charlotte, Vt.

No. 35. NEW RED APPLE, Greg., '84, '85, '87.

Differs from the Livingston's Favorite only in having slightly smaller fruit.

No. 36. PARAGON, Hen., '86; Liv., '86.

Syn. *New Paragon*, Thor., 87.

Closely resembles the Livingston's Perfection. The fruit is not quite so regular, and averages rather larger.

Introduced by A. W. Livingston, of Des Moines, Ia.

No. 37. TILDEN'S NEW, Greg., '83, '87.

Rather closely resembles Hathaway's Excelsior, but the fruit is not quite so regular and ripens less evenly, and the plant is less vigorous. In season they are about the same.

‡‡. Fruits purplish red.

§. Outline angular or corrugated.

No. 38. FEEJEE ISLAND RED, Thor., '83.

Syn. *Feejee Improved*, Greg., '87: *Feejee Island* (d), WHITE.

The Feejee of Burr, also the Perfected, Syn. Lester's Perfected, It., Pomo d'Oro Lesterano, is very probably this variety. The names Fidgi Island of Vil. and Fiji Island of Veg. Garden refer to a distinct sort.

Fruit large to very large, red, with numerous and somewhat conspicuous whitish specks sprinkled over the surface; oblate; outline angular, and sometimes rather strongly corrugated; cavity medium;

basin small in the more regular fruits, with a rather large russet spot at the bottom, ringed and fissured, often much distorted in the larger fruits; cells numerous, but usually small; flesh very thick, center remarkably well filled; firm; — plant extremely vigorous; foliage deep, dull, grayish green, leaflets broad, strongly blistered, deeply cut; calyx segments nearly or quite as long as corolla; — season very late.

No. 39. ROCHESTER, Sib., '83, '85, '87.

Syn. *Rochester Favorite*, Greg., '87.

Fruit scarcely distinguishable from that of the Mikado; — plant rather vigorous; leaves usually two-pinnate in the lower half; leaflets little blistered, rather remote, on rather long petioles, deeply cut, with rather sharp segments; — season medium.

Introduced by Hiram Sibley & Co. in 1883.

§§. Outline regular or nearly so.

No. 40. ACME, HEN.; Thor., '87; Veg. Gar.; Vil.

Syn. Apple-Shaped, VEG. GAR.: *Early Acme*, Liv., '86: *Hovey*, Thor., '87: *Jones' Early Hybrid*, Ev., '85: *Livingston's Acme*, Greg., '85: Fr., Tomate pomme violette, VIL.

Fruit medium, oblate, inclining to hemispherical; cavity shallow, usually slightly furrowed; basin usually none; skin very thin and delicate; cells 3 to 7; flesh very firm, ripens uniformly; — plant moderately vigorous; leaves largely 2-pinnate, leaflets thin; calyx segments a little shorter than the corolla.

An early variety, introduced by Mr. A. W. Livingston, of Des Moines, Ia. Its purplish color and somewhat harsh flavor are objected to by some; its thin skin does not bear shipping long distances and late in the season the fruits become rather small. But despite these faults it continues to be very popular in many localities.

No. 41. BURPEE'S CLIMAX, Burpee, '86.

Fruit of the size, form and regular outline of the Livingston's Favorite, but of the purplish red color of the Acme; — plant moderately vigorous; — season medium.

No. 42. CRITERION, Greg., '83, '87; VEG. GAR.; VIL.

Fruit small, averaging about 2¼ in. in diameter in both directions; obscurely cylindrical; outline regular or slightly angular; cavity very slight, often obscurely furrowed; basin wanting, the center marked only by a minute dot; cells usually 3 or 4; flesh very thick, moderately firm; — plants very vigorous; leaves largely 2-pinnate; leaflets somewhat shriveled; calyx segments nearly or quite as long as the corolla; — season rather early.

No. 43. ESSEX HYBRID, Thor., '87.

Syn. *Essex Early Hybrid*, Sib., '83.

Very closely resembles the Acme, but the foliage is more vigorous. It has often been called a synonym of the Acme.

No. 44. LIVINGSTON'S BEAUTY, Liv., '86, '87; Thor., '87.

Closely resembles the Acme, though said to be distinct from it in parentage. It differs from the Acme in being less oblate, having more solid flesh, and in producing less seed, with a rather more stocky plant. The size of the fruit also holds out rather better late in the season.

Introduced in 1886 by Mr. A. W. Livingston, of Des Moines, Ia.

No. 45. PEACH, Land., '87.

Fruit very small, the largest rarely 2 in. in diameter; of a peculiar dull purplish red, sometimes with distinct yellowish spots about the stem; globular but almost always a little angular, not longitudinally furrowed; cavity small; basin wanting; cells 3; flesh rather thin, not firm, with a sweet, pleasant flavor; — plant rather vigorous; foliage dull, slightly grayish green; leaves largely two-pinnate; leaflets not much blistered, very deeply cut, with sharp segments; flowers a shade lighter than in most other varieties; calyx lobes nearly or quite as long as the corolla; — season medium.

When not quite ripe, the fruit bears a rather striking resemblance to a rosy peach.

‡ ‡ ‡. Fruit yellow or orange.

§. Outline angular or corrugated.

No. 46. GOLDEN TROPHY, Thor., '83; Land., '85, '87.

Said to be a sport from the Trophy, differing from it in having somewhat smaller pale yellow fruit that often inclines a little to red; and a rather more vigorous plant. The flesh is often slightly tinged with red.

No. 47. LARGE YELLOW, Thor., '87.

Fruit medium to small; bright, clear yellow; strongly oblate; outline extremely irregular, always more or less angular or corrugated; cavity medium to large, often very deeply furrowed; basin wanting, the center marked by a mere dot in the more regular fruits, other samples representing all degrees of distortion; cells 8 to many, usually small, not always filled by the seeds; flesh rather soft, center very well filled; — plant very vigorous; leaves 2-pinnate in the lower half; leaflets rather deeply cut; calyx lobes nearly or quite as long as the corolla; — season medium.

No. 48. YELLOW VICTOR, Greg., '83, '87.

Fruit of medium size, bright, clear yellow; oblate; outline usually more or less angular, sometimes corrugated; cavity very small, scarcely furrowed; basin wanting in the smaller fruits, often fissured in the larger ones; cells 5 to 9, usually small; flesh moderately firm, center well filled; — plant moderately vigorous; leaves usually 2-pinnate in the lower half; leaflets rather strongly blistered and deeply cut; calyx segments $\frac{1}{2}$ to $\frac{3}{4}$ as long as the corolla; — season medium.

§§. **Outline regular or nearly so.**

No. 49. GOLDEN QUEEN, Liv., '85; Vil., '87.

Syn. Fr., *Tomate jaune grosse lisse*, Vil., '87.

Fruit large, light clear yellow; oblate; outline rarely somewhat angular; cavity small, usually little furrowed; basin small, with an inclination to become ringed, rarely sufficiently irregular to deform the fruit; cells numerous, small; flesh very thick, moderately firm, center well filled; — plant very vigorous; leaves not often 2-pinnate, leaflets very broad except toward the terminii of the branches, little blistered; — season medium.

Another GOLDEN QUEEN, seed from Thor., '87, was distinct from the above in having the fruit of medium size, and showing a considerable inclination toward red in the part opposite to the stem. The leaflets were also rather narrower, and the fruit ripened slightly earlier.

No. 50. GREEN-GAGE, Fer., '83; Thor., '83, '87; VIL.

Syn. *Carter's Green-Gage*, Ben., '86: Greengage, VEG. GAR: *Large Yellow*, Hen., '84; Yellow Plum, Vil.: Fr., Tomate jaune ronde, Vil.

Fruit small to very small, produced in clusters of 4 to 6; rich deep yellow; slightly oblate, inclining to spherical; cavity almost wanting, not furrowed; basin none; cells 2 to 5, large; flesh thick, rather soft, with a pleasant slightly acid flavor, center not well filled; — plant very vigorous; leaves rarely 2-pinnate; leaflets rather broad, considerably blistered; calyx segments nearly or quite as long as corolla.

One of the earliest varieties, but owing to its small size and soft texture is little used except for preserves. The skin cracks badly about the stem in wet weather.

Correctly figured in Veg. Gar., p. 571.

No. 51. IMPROVED LARGE YELLOW, Thor., '83, '87.

Resembles the Green Gage, but the color is deeper, approaching orange, the outline not quite so regular, the flesh firmer, and the skin does not crack so much about the stem in wet weather. The plant is rather less vigorous and the leaflets are often 2-pinnate in the lower half. In season it is considerably later than the Green Gage.

††††. Fruit whitish.

No. 52. IVORY BALL, Land., '87.

Syn. *New White Apple*, Thor., '83.

Fruit very small, the larger samples $1\frac{1}{2}$ to 2 in. in diameter, produced in clusters of 2 to 8; rather rich yellow about the stem, shading to nearly pure white in the opposite part, finely mottled with pure white specks; slightly oblate, approaching spherical; cavity very slight, sometimes obscurely furrowed; basin wanting; cells 2, 3 or 4; flesh thick, rather firm; plant very vigorous; leaves 2-pinnate in the lower half; leaflets deeply cut; calyx segments nearly or quite as long as corolla; — season medium.

**. Fruit two (sometimes three) celled, without a cavity about the stem.

†. Fruit spherical, *(var. cerasiforme)*.

‡. Fruit deep scarlet.

No. 53. RED CHERRY, Sib., '83; Thor., '87; Vil.

Syn. Cherry, Vil.: Fr., Tomate cerise, VIL.: Ger, Kirschförmige rothe Tomate, Vil.

Fruit very small, the largest about one inch in diameter, produced in clusters of 4 to 9; spherical; outline entirely regular; cavity and basin wanting; cells 2; flesh very thin; soft; — plant remarkably vigorous; foliage very deep clear green; leaves largely 2-pinnate; leaflets small, closely set, racemes simple, 2-ranked; calyx lobes one half to quite as long as the corolla; — season very early.

Correctly figured in Les pl. pot., p. 559.

‡‡‡. Fruit yellow.

No. 54. YELLOW CHERRY, Thor., '87, ?, '82.

Differs from the Red Cherry in having bright clear yellow instead of scarlet fruit, and in its foliage being a faint shade lighter in color.

††. Fruit oval or pyriform, *(var. oblongum).*

‡. Fruit deep scarlet.

No. 55. KING HUMBERT, Thor., '85.

Syn. *Early King Humbert*, Thor., '87: *Wonder of Italy*, Dam., '86.

Fruit very small, about 1¾ in. in diameter; pyriform, sometimes approaching oval; slightly flattened and obscurely furrowed on two opposite sides; cavity and basin wanting; cells 2 sometimes 3, rather large; flesh remarkably thick and firm; — plant vigorous; leaves usually 2-pinnate in the lower half; calyx lobes rather shorter than corolla.

The fruit is produced in clusters of 5 to 9, and ripens early. The calyx does not usually come off with the fruit.

The cut of this variety as given in Veg. Gar., p. 573, does not represent the King Humbert as grown at the Station.

No. 56. NESBIT'S VICTORIA, Till., '85.

Syn. Nisbett's Victoria (d), Vil.

The fruit resembles rather closely that of the King Humbert, but the foliage is quite distinct, the leaflets being remarkably large; not, however, resembling those of the Mikado type.

No. 57. PEAR-SHAPED, Thor., '87; Vil.

Syn. Fig, BURR; Vil.: Fr., Tomate poire, VIL.: Ger., Birnförmige rothe Tomate, Vil.

Fruit very small, the largest about 2 in. long, 1 in. in longest diameter; obovate or pyriform, usually obscurely 4-sided, with 2 obscure longitudinal furrows on opposite sides, but sometimes entirely smooth; cavity and basin wanting; cells 2; flesh thick, remarkably firm; — plant extremely vigorous; leaves not much blistered; calyx lobes ½ to ¾ as long as corolla; — season early.

Correctly figured in Les pl. pot., p. 560.

††††††. Fruit yellow.

No. 58. YELLOW PEAR-SHAPED, BURR.

Syn. *Pear-Shaped Yellow*, Sib., '83; Thor., '87: *Yellow Fig*, Burr; Greg., '83, '87.

Scarcely differs from the Pear-shaped except in the color of the fruit, which is bright clear yellow instead of scarlet.

No. 59. YELLOW PLUM, Burr; Thor., '83, '87.

Differs from the Yellow Pear-shaped chiefly in having oval rather than pyriform fruit.

b. Leaflets few and very large, never pinnate, nearly or quite entire. (*Sub-var. grandifolium.*)

‡. Fruit deep scarlet.

§. Outline angular or corrugated.

No. 60. BROAD-LEAVED DWARF, Thor., '83.

Syn. *Keye's Early Prolific*, Greg., '83.

Fruit medium to small, produced in clusters of 2 to 6; strongly oblate; outline usually more or less angular, sometimes corrugated; cavity shallow, very little furrowed; basin wanting in the more regular fruits; cells 4 to 7; flesh rather firm; — plant moderately vigorous; foliage very similar to that of the Mikado; — season very early.

‡‡. Fruit purplish red.

§. Outline angular or corrugated.

No. 61. MIKADO, Hen., '86; Thor., '87.

Syn. *Turner's Hybrid*, Thor., '87.

Fruit large to very large; strongly oblate; outline often strongly corrugated; cavity deep, broad, distinctly, often deeply furrowed; basin shallow, irregular, often much fissured and distorted; cells numerous, small; flesh thick, moderately firm, center very well filled; — plant vigorous; foliage pale green; leaves never 2-pinnate; leaflets rarely more than 5, oblong cordate, rarely equal at the base, surface strongly blistered, more or less waved; calyx lobes as long as the corolla.

§§. Outline regular.

No. 62. POTATO LEAF, Liv., '86.

A tomato of which the fruit scarcely differs from that of the Acme except in being rather firmer; and the foliage from that of the Mikado except that it is deeper green. In season it is about the same as the Acme.

Introduced by Josiah Livingston, of Des Moines, Ia., in 1886.

B. Stem stocky, plant erect or nearly so (*sub-var. validum*).

‡. Fruit deep scarlet.

§. Fruit angular or corrugated.

No. 63. TREE, BURR.; Vil.; Thor.?, '82.

Syn. *Greneir*, Ben., '86: *New French Upright*, Thor., '83: New Upright, Burr: Upright, Vil.: Fr., Tomate à tige raide de Laye, VIL.: T. de Laye, Burr: *T. Grenier à tige raide de Laye*, Ben., '86: *T. rouge à tige raide de Laye*, Ben., 86.

Fruit large; oblate; outline usually more or less corrugated; basin irregular, often fissured; cells numerous, small; flesh firm, center very well filled; — season very late.

The fruit is of excellent quality, but so late as to be of little value in the Northern States.

§§. Fruit regular or nearly so.

No. 64. STATION, N. Y. Agr. Exp. Sta., '86, '87.

Fruit medium to small; slightly oblate, sometimes inclining to spherical; outline regular, or slightly angular; cavity small, usually slightly furrowed; basin wanting, the center marked by a small dot; cells 4 to 8; flesh thick, moderately firm, center usually well filled; — season very early.

Originated at the New York Agricultural Experiment Station in 1883, from the Tree tomato fertilized with the Alpha.

2. Plant not strongly scented, stem smooth, leaflets entire (*Lycopersicum pimpinellifolium*).

‡. Fruit deep scarlet.

No. 65. NEW CURRANT, Thor., '83, '87.

Syn. Red Currant, Vil.: Ger., Johannisbeer Tomate, Vil.: Trauben T., A. de Cl.

Already well described in the introduction under the name *Lycopersicum pimpinellifolium.* The fruits rarely exceed ½ in. in diameter are 2, rarely 3 celled, with thin but remarkably firm flesh; foliage very pale green, leaves never 2-pinnate; leaflets nearly smooth; flowers small, bright yellow, never united, petals long and narrow; calyx lobes less than half as long as the corolla.

Grown for preserves and for ornament. The fruit ripens extremely early, commencing at the base of the racemes.

Correctly figured in Les. pl. pot., p. 560.

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EXPLANATION OF ABBREVIATIONS.

In order to economize space, the following abbreviations of the names of seedsmen are used in the Reports of the Horticulturist and Assistant Horticulturist.

An abbreviation of the name of a seedsman attached to a variety, indicates the source of the seed, and the date following, the year in which it was obtained. In the Report of the Assistant Horticulturist, the date is omitted in all seeds obtained in 1887.

Alb.— Silas L. Albertson, Roslyn, L. I., N. Y.
Alex.— O. H. Alexander, Charlotte, Vt.
Ans.— A. H. Ansley & Sons, Milo Center, Yates Co., N. Y.
Ben.— Ernst Benary, Erfurt, Germany.
Bliss — B. K. Bliss & Sons, New York, N. Y.
Brill — Francis Brill, Riverhead, L. I., N. Y.
Carter — Carter & Co., London, England.
Cleve.— A. B. Cleveland, Cape Vincent, N. Y.
Coy — E. L. Coy & Son, West Hebron, Washington Co., N. Y.
Dam. — Damman & Co., Portici, Italy.
D. of A.— Department of Agriculture, Washington, D. C.
Ev. or Evt.— J. A. Everitt & Co., Indianapolis, Ind.
Farq.— R. & J. Farquhar & Co., Boston, Mass.
Ferry — D. M. Ferry & Co., Detroit, Mich.
Foote — A. J. Foote, Terre Haute, Ind.
Greg.— J. J. H. Gregory, Marblehead, Mass.
Hen.— Peter Henderson & Co., New York, N. Y.
H. & S.— Haage & Schmidt, Erfurt, Germany.
H. & W.— Howcroft & Watkins, London, England.
Hors.— F. H. Horsford, Charlotte, Vt.
J. & S.— Johnson & Stokes, Philadelphia, Pa.
Land.— David Landreth & Sons, Philadelphia, Pa.
Liv.— A. W. Livingston's Sons, Columbus, Ohio.
Maule — Wm. Henry Maule, Philadelphia, Pa.
Morrell — R. L. Morrell, Plymouth, Ind.
Pier.— M. F. Pierson, Seneca Castle, N. Y.
Raw.— W. W. Rawson & Co., Boston, Mass.
Rice — Jerome B. Rice, Cambridge, N. Y.
Sib.— Hiram Sibley & Co., Rochester, N. Y.
Sta.— Station.
Thor.— J. M. Thorburn & Co., New York, N. Y.
Till.— I. F. Tillinghast, La Plume, Pa.
Vick — James Vick, Rochester, N. Y.
Vil.— Vilmorin, Andrieux et Cie., Paris, France.
Wells — S. M. and D. Wells, Wethersfield, Conn.
Will.— J. S. Williston, Athens, Pa.

REPORT OF THE ASSISTANT HORTICULTURIST.*

INTRODUCTION.

In addition to the regular statistical work in the garden and orchard, a special study of the potato scab has been undertaken the past season. Brief notes are added upon other subjects as named below.

The topics are reported in the following order:

A study of the potato scab.
Notes on insects.
A fungus disease of the cucumber.
Notes on garden vegetables.
Notes on fruits.

Potato Scab.

A peculiar rusty scab-like appearance of the potato tuber is known as the "potato scab." It often extends deep into the body of the tuber, causing a considerable loss of substance. The edible qualities of the tubers thus affected are not injured, but their market value is greatly lessened.

A German authority† on plant diseases describes the potato scab as "consisting of a greatly increased formation of cork. The connecting wall-formed layer of cork cells which form the normal skin of the potato are thereby changed, so that the otherwise tabular cork cells become distended, round and bladder-like. This tissue lying beneath the skin produces new cork cells which force the older cells upward."

Various theories have been advanced concerning the cause of the scab, and not a little study has been given to the subject. At the present time little appears to be known concerning the true cause. Plowright‡ says: "As usually met with, each scab consists of a circumscribed cork formation of the rind of the tuber, as if each spot had at some earlier period of its existence been the seat of the injury. Most likely this precursory injury will be found due to a fungus of some sort, possibly to some mould, to prevent the penetration of which the tuber has developed a cork plate."

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*M. H. Beckwith.

†Soraur's Handbuch der Pflanzen Krankheiten, p. 84, ed. 1874.

‡C. B. Plowright, On Potato Diseases, Gardeners' Chron., Vol. 23, 1885, p. 60.

The scab is one of those phenomena concerning whose nature and cause the most diverse opinions prevail.

Several microscopical examinations of scabby tubers in various stages of the scab were made at this Station by Dr. J. C. Arthur, without detecting the presence of any fungus. I have been unable to find any reliable data indicating that the scab is caused by any known fungus. No remedy has been found that proves entirely successful in preventing the disease. The following experiments were attempted with a view of accumulating data to determine the cause and secure a remedy.

INFLUENCE OF SOIL.

In order to determine the influence of different kinds of soil in producing scab, medium-sized tubers that were smooth (or free from scab) were planted in eight-inch pots containing different soils, and placed in the greenhouse February 17. Four kinds of soil were used, two pots of each, muck, sand, garden soil and clay. After planting, all were treated as nearly alike as possible. The products of the tubers were removed from the pots May 31, after the tops were all dead, and carefully examined for scab. The per cent of scabby tubers and also the degree of scab were as follows:

	Whole No. of tubers.	Per cent scabby.	Degree of scab.
Muck	13	62	1
Sand	3	100	2
Garden soil	8	100	3
Clay	3	100	4

The muck proved the least favorable to the production of the scab. It was the only soil that produced any tubers entirely free from scab. The scabby tubers were affected in a less degree than those grown in the other soils. All the tubers grown in the other soils were more or less scabby, those grown in sand ranked next in degree of scabbiness, those in clay were the most affected. It is not safe to generalize from an experiment on so limited a scale, yet the result tends to show that soils of a loose, porous character produce tubers less affected by scab than those of a heavy, tenacious nature.

THE EFFECTS OF EXCESSIVE MOISTURE ON THE PRODUCTION OF SCAB.

On May 6, forty-five rows of potatoes, each row containing eight hills, were planted near the water-tank in the west garden in such a manner that four hills of each row could be irrigated and four remain unirrigated. The seed used was the White Star variety, except the first row, which was a red-skinned seedling free from scab. A dry season made the conditions very favorable for this experiment. Irrigation was begun July 19, when the tubers had just commenced to form, by allowing a small stream of water to run during the hours from 6 P. M. to 7 A. M. between two of the four hills extending across the whole number of rows. This was continued until October 15, at which time each hill of potatoes was dug separately, each tuber examined for scab, and a record made of the whole number of tubers and the number of scabby tubers.

Twenty-two rows were planted with scabby tubers, and twenty-three with tubers entirely free from scab, in the following manner: First row, a red-skinned seedling free from scab, then two rows of scabby tubers of the White Star variety, next two rows with tubers of same variety free from scab, and so on alternately two rows scabby and two without scab. The tubers of each four rows thus planted were treated with a different substance intended as a preventive of the scab, which will be shown in the table that follows. The twenty-two rows on the south end of the planting were manured with stable manure before plowing the land.

TABLE A.

TREATMENT.	SCABBY SEED.				SMOOTH SEED.			
	IRRIGATED.		UNIRRIGATED.		IRRIGATED.		UNIRRIGATED.	
	Whole number of tubers.	Per ct. scabby.	Whole number of tubers.	Per ct. scabby.	Whole number of tubers.	Per ct. scabby.	Whole number of tubers.	Per ct. scabby.
UNMANURED.								
Untreated	....	....	....	....	19	84	21	47
Hyposulphite of soda	9	56	55	16	66	27	42	33
Sulphate of iron	80	22	116	22	77	12	81	18
Sulphate of copper	28	7	41	0	4	0	21	0
Mercury chloride	92	23	111	15	92	5	85	10
Salicylic acid	112	40	111	54	101	25	77	23
Carbolic acid	55	29	34	9	59	8	97	13
MANURED.								
Sulphur	100	49	123	41	125	56	139	19
Muriate of potash	83	83	104	33	65	80	84	20
Sulphate of potash	82	58	84	26	98	63	79	25
Air-slaked lime	104	89	105	22	89	80	76	50
Ground bone	78	87	77	90	59	85	105	86

Untreated.—Ordinary culture, smooth seed, 279 potatoes; 163 scabby, or 58.4 per cent.

Comparing the irrigated with the unirrigated portion, the following result is obtained:

	Total No. of tubers.	Per cent. scabby.
Irrigated	1,658	48
Unirrigated	1,868	31

The number of scabby tubers in the product of the irrigated portion exceeds the number of scabby tubers in that unirrigated by 17 per cent, which tends to indicate that excessive moisture favors the production of scab. This result coincides with the work of Nobbe.*

Comparing the product of the scabby seed of the irrigated and the unirrigated portions with that of the smooth seed of the irrigated and unirrigated portions resulted as follows:

Scabby Seed.

	Whole No. of tubers.	Per cent. scabby.
Irrigated	823	57
Unirrigated	961	32

Smooth Seed.

	Whole No. of tubers.	Per cent. scabby.
Irrigated	835	44
Unirrigated	907	29

It appears that there were 25 per cent more scabby tubers in the irrigated portion planted with scabby seed than in the unirrigated, and 15 per cent more scabby tubers in the irrigated portion planted with smooth seed than in the unirrigated; or 10 per cent more scabby tubers from the scabby than from the smooth seed.

The difference in the per cent of scabby tubers in the products of the smooth and the scabby seed does not appear striking, and does not in this case tend to disparage the use of scabby tubers for seed.

Comparing the manured and unmanured portions, the following data are obtained:

Unmanured.

	Whole No. of tubers.	Per cent. scabby.
Irrigated	775	22
Unirrigated	468	21

---

*Nobbe found in the water culture of the potato that, from the first formation of the tubers grown in water, very small warts were produced by excessive local growth of cork. These were not found in the tubers grown in the air. Soraur's Handbuch der Pflanzen Krankheiten, p. 84, ed. 1874.

Manured.

	Whole No. of tubers.	Per cent. scabby.
Irrigated	883	71
Unirrigated	996	30

Practically there was no difference in the percentage of scabby tubers between the irrigated and unirrigated portion that was not manured. In the manured portion the number of scabby tubers was 41 per cent greater in the irrigated than in the unirrigated.

THE RELATION BETWEEN COLOR OF SKIN AND THE LIABILITY TO SCAB.

To determine if any relation existed between the color of the skin of the potato tubers and the liability to scab, the yields of eleven hills each of forty-five different varieties tested in the garden were examined and counted with the following result:

	Whole No. of tubers.	Per cent. scabby.
Dark-skinned varieties	531	27
White-skinned varieties	1,076	43
Flesh-colored varieties	529	53

It appears that the dark-skinned varieties gave a smaller percentage of scabby tubers than the white varieties. Those having a flesh-colored skin appear to be most susceptible to the scab, the percentage of scabby tubers being greater than in either the white or dark-skinned varieties. Taking the average percentage of the scabby tubers produced by all the light-skinned varieties examined, forty-eight per cent were scabby. In this case the dark-skinned varieties were the least susceptible to scab.

TABLE B.

LIGHT VS. DARK-SKINNED VARIETIES.

	SEED.	Number of scabby tubers.	Number of smooth tubers.	Per cent scabby.
Row 1..	White Star free from scab............	17	20	46.9
2..		20	21	49.7
3..		32	15	66.8
4..		14	11	56
5..		14	23	37.8
	Total number of tubers and average per cent scabby......................	97	90	51.4
Row 6..	Red-skinned seedling free from scab...	1	18	5.2
7..		2	17	10.5
8..		3	7	30
9..		3	20	13.4
10..		10	11	47.6
	Total number of tubers and average per cent scabby......................	19	73	21.3

In the above table B, each row contained four hills planted with medium sized tubers entirely free from scab. The data obtained show that the product of the light-colored tubers contained nearly thirty per cent more scabby tubers than that of the dark-colored. Also that an increased percentage of scabby tubers accompanied an increase in the yield.

FUNGICIDES AS A PREVENTIVE OF SCAB.

The following experiments were made to determine the efficacy of various substances to prevent the potato scab. Tubers treated with hyposulphite of soda, sulphate of iron, mercury chloride and sulphur, were planted in eight-inch pots filled with potting soil and placed in the greenhouse February 17. The method of treatment and the results are given in the following table:

	Number of tubers.	Per cent scabby.	Degree of scab.
Hyposulphite of soda, 4 oz. to 1 pt. water	5	100	1
Sulphate of iron, 1 oz. to 1 pt. water	2	100	3
Mercury chloride, 1 part to 1,000 parts water	9	89	3
Mercury chloride, 1 part to 1,000 parts water*	1	100	3
Tubers moistened and rolled in sulphur	5	60	1

Eight medium-sized tubers were treated eighteen hours, two tubers with each substance as stated in the above table, and planted separately. The same number of tubers were allowed to remain in the solutions 48 hours, all of which failed to vegetate except those treated with mercury chloride. Sulphur and mercury chloride both appear in this case to have been slightly beneficial.

Another test of substances to prevent the scab was made on a larger scale in the garden. The different substances used and the method of treatment were as follows:

Hyposulphite of soda, 4 oz. dissolved in 1 qt. of water.
Sulphate of iron, 4 oz. dissolved in 1 qt. of water.
Sulphate of copper, 4 oz. dissolved in 1 qt. of water.
Mercury chloride, 1 part to 1,000 parts of water.
Salicylic acid, a saturated solution.
Carbolic acid, 1 part to 100 parts of water.
Powdered sulphur, 1 tablespoonful in each hill.
Muriate of potash, ½ oz. in each hill.
Sulphate of potash, ½ oz. in each hill.
Air-slacked lime, 1 tablespoonful in each hill.
Ground bone, 1 tablespoonful in each hill.

The data of this experiment are given in table A on page 309. In this test all the substances used appeared more or less beneficial, except the ground bone, which produced the greatest per cent of scabby tubers. The percentage of scabby tubers in nearly all other rows was less than in the untreated row. The sulphate of copper appeared the most efficacious in preventing the scab. Three of the four rows treated produced tubers entirely free from scab; the fourth row produced only two scabby tubers, or seven per cent of the whole number of tubers. None of the other rows were entirely free from scab.

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* Treated 48 hours.

SCABBY *vs.* SMOOTH SEED TUBERS.

It is quite important to know whether the product will be less affected by scab when tubers free from scab are planted than when scabby tubers are used.

Duplicate plantings, as given in the following table, were made in eight-inch pots, filled with potting soil and placed in the green-house February 19. All were treated as nearly alike as possible.

TABLE — SEED.

SEED.	Number of tubers scabby.	No. of tubers free from scab.	Per cent scabby	Degree of scab.
Tubers free from scab	6	0	100	2
Duplicate	1	0	100	1
Tuber free from scab planted with scabby tuber	4	0	100	1
Duplicate	0	1	0	0
Tuber free from scab watered with water in which scabby tubers were soaked	2	0	100	3
Duplicate	3	1	75	1

In this experiment nothing appears to have been gained by using tubers free from scab. In the products of both of the tubers free from scab, every tuber was more or less scabby. In the two plantings of a smooth and scabby tuber in the same pot, the product of one was four tubers, all scabby, and of the other one tuber free from scab. The plantings of smooth tubers watered with the liquid in which scabby tubers had been soaked for 48 hours, in each case produced some scabby tubers and one tuber free from scab.

Comparing the yield of smooth and scabby tubers, as given in the table A, page 309, we obtain the following data:

Scabby Seed.

	Whole No. of tubers.	Per cent scabby.
Irrigated	823	57
Unirrigated	961	32

Smooth Seed.

	Whole No. of tubers.	Per cent scabby.
Irrigated	835	44
Unirrigated	907	29

This shows 25 per cent more scabby tubers in the irrigated portion planted with scabby seed than in the unirrigated, and 15 per cent more scabby tubers in the irrigated portion planted with smooth seed than in the unirrigated; or 10 per cent more scabby tubers from the scabby than from smooth seed. The difference is not sufficiently striking to justify the conclusion that any gain results from planting tubers free from scab.

The data obtained from the foregoing experiments indicate that:

The scab was not primarily caused by a fungus.

It was not due to the work of insects.

In nearly every instance an increased yield was accompanied by an increased percentage of scabby tubers.

Any marked change in the rapidity of growth, either an increase or a decrease, tends to an increased production of scab.

A continuous growth from the time of first vegetation until the tubers are fully matured appears to be the condition least favorable to the production of scabby tubers.

QUINCE CURCULIO.

Specimens of fruit that were injured by an insect were received from the quince orchard of Messrs. Maxwell & Scoon. The larva in the fruit was identified as that of the quince curculio, *Conotrachelus cratægi*, Walsh. The identification was verified by Dr. Lintner, from specimens of the larvæ sent to him.

The quince crop in this section has been much injured by the ravages of this insect for the past two seasons. Many of the insects may be destroyed in the spring by the jarring method that has been so successfully employed for the plum curculio.

"The insect bears a family resemblance to the plum-curculio, being larger, with a longer beak or snout, and a body which is broadest across the base of the wing covers. Instead of the crescent cut characteristic of the plum curculio, it simply makes a puncture for the reception of its eggs. After about a month's feeding the larvæ leave the fruit and burrow into the earth, where they remain unchanged from the larval state until early in May, when they transform to pupæ and shortly after that to the perfect insect."*

The cultivation of the orchard, late in autumn and early in spring, before the larvæ transform into the perfect insects, will undoubtedly destroy great numbers of the larvæ and greatly lessen the ravages of the insects.

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*Second annual report on the Injurious and Other Insects of N. Y., by J. A. Lintner, p. 11.

THRIPS IN STRAWBERRY BLOSSOMS.

On June 27, numerous minute insects were found in strawberry blossoms, which appeared to be feeding upon the pollen. Specimens of the blossoms containing the insects were sent to Dr. J. A. Lintner, State Entomologist, who identified the insects as belonging to the family of *Thripidæ*. It was the first account he had received of their appearance in this State. The strawberry crop in Illinois was greatly injured by their ravages in 1886, but I could not perceive that they caused any injury to our crop.

No remedy was tried, as the insects disappeared as suddenly as they came.

A FUNGUS DISEASE OF THE CUCUMBER.

The green fruits of the cucumber growing in the Station garden were found to have received injuries that rendered them unfit for pickling. The injury consisted of numerous small, round, shallow depressions, from $\frac{1}{8}$ to $\frac{1}{4}$ of an inch in diameter, from which at first a gummy-like substance exuded. Afterwards this substance appeared to dry up, leaving the depression covered with a thin film of black substance.

These injuries appeared as though they had been caused by an insect, but a microscopical examination by Dr. J. C. Arthur revealed the fact that the trouble was really due to a fungus allied to the Fusicladium and Cladosporium.

"The spots are caused by the growth of a fungus, a species of Cladosporium, very similar in microscopic characters to Cladosporium herbarum, which grows on all kinds of dead and dying vegetation. But as the growth in this case is upon otherwise perfectly healthy fruit, it may be doubted if it is that species. The fungus produces on the surface of the spots great numbers of two-celled spores which germinate in a few hours after being placed in water. The rapidity with which the fungus can be disseminated indicates a probability of its becoming as general and formidable a disease as tomato rot is at the present time."—J. C. ARTHUR.

NOTES ON GARDEN VEGETABLES.

BEET.

In testing the varieties of beets and mangels, those named in the following tables were planted April 22, in rows twelve feet long and forty-two inches apart, one row to each name. The land devoted to testing vegetables was liberally manured with well-rotted manure, and plowed in the fall of 1886. The ground was kept free from weeds and the plants in the rows thinned to about six inches apart.

The explanation of abbreviations used is placed at the end of the report of the horticulturist.

The date when the beet roots in each row were of edible size, the number and average weight of the roots harvested, were as follows :

BEET.	Seed from	Of edible size.	Days from planting.	Number of roots.	Av'age weight in ounces at harvest.
Bastian's Blood Turnip	Hen.	June 15	54	28	24
Bastian's Blood Turnip	Thor.	“ 15	54	25	20
Bastian's Extra Early Turnip	Hen	“ 15	54	26	23
Bastian's Half Long Blood	Hen	“ 18	57	23	37
Crosby's Early Egyptian	Greg.	“ 12	51	34	9
Dewing's Early Blood Turnip	Greg.	“ 13	52	30	20
Dewing's Extra Early Turnip	Thor.	“ 13	52	37	24
Dewing's Improved Blood Turnip	Hen.	“ 15	54	31	19
Dracœna Leaf (Fr., rouge à feuillage ornamentale)	Vil.	“ 18	57	20	14
Early Bassano	Thor	“ 12	51	26	24
Early Blood Turnip	Thor	“ 14	53	28	27
Early Flat Bassano	Hen	“ 12	51	33	27
Early Yellow Turnip	Hen	“ 12	51	31	18
Early Yellow Turnip	Thor	“ 15	54	34	22
Eclipse	Greg.	“ 12	51	32	21
Eclipse	Thor	“ 12	51	33	23
Egyptian	Greg.	“ 12	51	41	15
Extra Early Egyptian Turnip	Thor	“ 12	51	41	22
Henderson's Pine Apple	Hen	“ 18	57	30	37
Improved Long Smooth Blood	Thor	“ 16	55	29	24
Long Smooth Blood	Thor.	“ 16	55	23	40
Long Smooth Blood Red	Hen	“ 16	55	26	32
Long Smooth Dark Blood	Greg.	“ 16	55	30	33
New Early Red Flat Turin	Thor.	“ 15	54	27	25
Pine Apple	Hen	“ 18	57	40	13
Round Yellow Turnip	Greg.	“ 14	53	33	16

MANGEL.	Seed from	Number of roots.	Av'age weight in ounces at harvest.
Carter's Orange Globe	Greg.	32	31
Golden Ovoid	Greg.	30	39
Golden Tankard	Greg.	19	43
Henderson's Champion Yellow Globe	Hen	30	38
Henderson's Colossal	Hen	34	31
Knauer's Improved Imperial	Greg.	21	35
Norbitan Giant	Greg.	32	30
Red Giant Ovoid	Greg.	24	30
Red Tankard	Greg.	26	28
Webb's New Kinver Yellow Globe	Greg.	35	40

CARROT.

Seeds of the following list of carrots were planted April 14, in the same manner as the beet. The plants in the rows were not thinned until late in the season, in consequence of which the roots did not attain a large size.

The same data are given in the table as for the beets.

CARROT.	Seed from	Of edible size.		Days from planting.	Number of roots.	Average weight per root in ozs. at harvest.
Altringham	Hen	July	18	95	30	7
Carentan	Thor	"	18	95	131	3
Chantenay Half Long Scarlet	Greg.	"	18	95	216	2
Chantenay Stump Rooted	Vick	"	16	93	130	3
Chantenay Half Long Scarlet, stump rooted. (Fr., rouge demi longue de Chantenay)	Vil	"	18	95	62	5
Danvers	Greg.	"	17	94	143	2
Danvers	Thor	"	17	94	149	2
Early French Forcing	Hen	"	15	92	60	3
Early Half Long Pointed	Hen	"	16	93	128	2
Early Horn	Thor	"	15	92	77	3
Early Scarlet Horn	Greg.	"	15	92	104	3
Early Very Short Scarlet	Greg.	"	15	92	54	4
Extra Early Forcing	Thor	"	15	92	54	3
Guerande	Greg.	"	15	92	55	6
Half Long Red Pointed	Thor	"	16	93	89	3
Half Long Red (stump rooted)	Hen	"	18	95	142	2
Half Long Stump Rooted	Thor	"	16	93	110	2
Half Long Stump Rooted Nantes	Thor	"	17	94	203	1
Henderson's Intermediate Red	Hen	"	20	97	161	2
Improved Long Orange	Greg.	"	23	100	197	2
Long Orange	Greg.	"	23	100	149	2
Long Orange	Thor	"	23	100	168	2
Long White	Greg.	"	24	101	47	6
New Guerande	Thor	"	18	95	54	2
New Half Long Luc	Thor	"	16	93	44	5
White Belgian	Thor	"	23	100	49	7

ONION.

In the following list of onions the seeds were planted April 14, two rows of each name, twelve feet long, the rows twenty-one inches apart. The bulbs of one row of each name were thinned when they began to crowd, to one inch apart; the other row was left without thinning. The number of bulbs, weight per row and per hundred bulbs are given in the following table:

TABLE—ONIONS—(*Continued*).

ONION.	Seed from	First ripe.	Days from planting.	THINNED ROW. No. of bulbs.	THINNED ROW. Wt. per row in ounces.	THINNED ROW. Wt. in ounces, calculated per 100 bulbs.	UNTHINNED ROW. No. of bulbs.	UNTHINNED ROW. Wt. per row in ounces.	UNTHINNED ROW. Wt. in ounces calculated per 100 bulbs.
Bright Red Mezieres (Fr., rouge vif de Mézierês)	Vil.	Aug. 4	113	57	247	433	78	275	340
Early Flat Red	Greg.	July 25	103	80	176	220	92	174	189
Early Red Flat	Thor.	July 25	103	66	154	233	145	203	140
Early Red Globe	Greg.	July 25	103	78	157	201	142	233	109
Early Round Yellow Danvers	Greg.	July 13	91	91	98	108	214	190	89
Early Yellow Cracker	Greg.	July 13	91	45	88	186	203	167	82
Extra Early Red	Hen	July 13	91	74	121	164	181	187	103
Flat Madeira	Thor.	Aug. 3	112	80	240	300	184	398	216
Giant Globe	D. of A.	July 27	105	52	105	202	101	157	155
Giant Red Flat Italian Tripoli	Hen	July 13	191	72	56	78	220	123	56
Giant Rocco	Thor.	Aug. 4	113	65	374	575	97	407	420
Giant White Garganus	Thor.	Aug. 6	115	86	236	262	179	310	173
Landreth's Golden Ball	Land.	Aug. 4	113	57	186	326	139	241	173
Large Brown St. Laurent (Fr., jaune brun de St. Laurent)	Vil.	Aug. 6	116	....	....	....	127	252	198
Large Red	Thor.	Aug. 4	113	67	121	175	142	167	118
Large White Italian Tripoli	Hen	July 11	89	81	43	53	257	96	37
Large White Tripoli	Thor.	July 27	105	54	47	87	77	260	338
Mammoth Tripoli	Greg.	July 28	106	72	77	107	96	136	141
Nasbey's Mammoth	Greg.	Aug. 4	113	79	169	214	144	271	190
New Queen	Greg.	July 9	87	62	24	39	98	26	27
Pale red Bermuda	Thor.	July 28	106	89	138	156	193	222	115
Pear-Shaped Early Yellow (Fr., pyriforme jaune hâtif)	Vil.	July 13	91	85	65	76	217	134	62
Philadelphia White	Greg.	July 28	106	66	65	98	132	109	83
Queen	Thor.	July 9	87	54	26	48	50	24	48
Red Pearl	Thor.	July 27	105	70	92	131	118	108	91
Round Yellow Danvers	Hen	July 28	106	72	88	122	244	150	61

TABLE — ONIONS — (*Continued*).

ONION.	Seed from	First ripe.	Days from planting.	THINNED ROW.			UNTHINNED ROW.		
				No, of bulbs.	Wt. per row in ounces.	Wt. in ounces calculated per 100 bulbs.	No. of bulbs.	Wt. per row in ounces.	Wt. in ounces calculated per 100 bulbs.
Russian Yellow Hard Improved (Fr., jaune chair de Russie acclimaté)	Vil.	Aug. 5	114	95	90	105	129	216	167
Southport Late Red Globe	Greg.	Aug. 4	113	94	155	166	134	189	141
Southport White Globe	Greg.	Aug. 4	113	82	166	202	....	....	.....
Teneriffe or Early Bermuda	Greg.	July 9	87	34	14	41	32	21	66
White Flat Italian	Greg.	Aug. 10	119	95	193	203	110	210	191
White Flat Maggiajola	Thor.	July 11	89	101	47	46	200	88	45
White Globe	Thor.	July 28	106	53	188	354	71	262	383
White Pearl	Greg.	July 9	87	71	36	51	143	60	42
White Portugal	Greg.	July 28	106	79	92	116	126	124	98
White Portugal	Thor.	Aug. 4	113	84	135	161	163	212	130
Yellow Danvers	Thor.	July 26	104	80	83	96	164	145	88
Yellow Dutch or Strasburgh	Hen	July 26	104	86	86	100	280	178	64
Yellow Globe	Thor.	July 26	104	112	103	92	68	74	19
Yellow Globe Danvers	Thor.	July 26	104	74	149	201	184	266	145
Yellow Globe Danvers (Cal. seed)	Till.	July 26	104	51	137	269	54	138	256
Yellow Globe Danvers (N. J. seed)	Till.	July 26	104	10	19	190	15	35	233
Yellow Globe Danvers (Wash. Ter'y seed)	Till.	July 26	104	60	79	131	60	184	115
Yellow Strasburg or Large Yellow	Greg.	July 26	104	73	186	118	111	156	141

In this test the unthinned rows in nearly every case produced the greatest weight of bulbs, and the thinned rows the largest bulbs·

MELON.

The following list of melons were planted May 9 on inverted sods in the cold frame and were transplanted to the garden May 25 in rows twelve feet long and seven feet apart. The transplanting did not appear to retard the growth of the plants.

The data noted are as follows:

MUSKMELON.	Seed from	First bloom.	Days from planting.	First ripe fruit.	Days from planting.
Bellegarde Canteloup (Fr., de Bellegarde)	Vil.	July 8	60	Sept. 6	120
Burpee's Champion Market	Greg.	June 21	43	Aug. 26	109
Burpee's Champion Market	Sib.	" 20	42	" 26	109
Creole or New Orleans Market	Sib.	" 18	40	" 18	101
Extra Early Canteloupe	Greg.	" 17	39	" 6	89
Golden Gem	Sib.	" 16	38	" 22	105
Golden Netted Gem	Thor.	" 17	39	" 11	95
Jenny Lind	Thor.	" 17	39	" 12	94
Miller's Cream	Greg.	" 20	42	" 27	116
New Early Hackensack	Hen.	" 20	42	" 11	94
Prolific Nutmeg	Vick.	" 20	42	" 23	100
Reedland Giant	Land.	" 21	43	" 16	99

WATERMELON.	Seed from	First bloom.	Days from planting.	First ripe fruit.	Days from planting.
Florida Favorite	Greg.	July 5	57	Aug. 13	96
Florida Favorite	Sib.	" 5	57	" 14	97
Florida Favorite	Vick.	" 5	57	" 14	97
Kolb's Gem	Hen.	" 2	54	" 16	99
Landreth's Boss	Land.	" 2	54	" 18	101
Mammoth Ironclad	Sib.	" 8	60	" 23	106
Oemler's Triumph	Greg.	" 1	53	" 13	96
Oemler's Triumph	Thor.	" 1	53	" 15	98
Pride of Georgia	Sib.	" 5	57	" 15	98
Seikon	Vil.	" 1	53	" 22	105
Stokes' Extra Early	Greg.	" 2	54	" 17	100
Volga	Hen.	" 1	53	" 20	103

The Extra Early Canteloupe was the earliest to ripen. It matured the first fruit in 89 days from date of planting.

The latest was the Bellegrade Canteloup, which ripened its first fruit 120 days from date of planting.

The Creole or New Orleans Market, Reedland Giant and the New Early Hackensack produced very large fruits.

One specimen of the Creole or New Orleans Market melon was tested which weighed 9 lbs. 2 oz.; flesh yellowish green, very thick and quite firm, rather coarse texture, flavor fair to good, not rich.

Reedland Giant resembles the Creole except in shape, which is oblong instead of round.

CUCUMBER.

The following list of cucumbers was planted May 9, in the same manner as the melons:

CUCUMBERS.	Seed from	First bloom.	Of pickle size.	First ripe fruit.
Bismarck	Greg.	June 20	July 9	Sept. 21
Boston Pickling	Thor.	“ 16	“ 2	Aug. 2
Early Cluster	Greg.	“ 16	“ 2	“ 2
Early Green Cluster	Thor.	“ 16	“ 1	July 23
Early Russian	Thor.	“ 16	“ 2	Aug. 1
Early Short Green	Thor.	“ 17	“ 1	July 19
Early White Japan	Thor.	“ 27	“ 9	Aug. 9
Early White Spined	Thor.	“ 21	“ 6	“ 6
Early Yellow Dutch (Fr., jaune hâtif de Hollande)	Vil.	“ 20	“ 4	“ 4
Extra Early Green Prolific	Hen.	“ 16	“ 2	July 23
Extra Long Green Smooth	Greg.	“ 20	“ 5	Aug. 6
Extra Long White Spined	Thor.	“ 20	“ 5	Sept. 21
Green Prolific Pickling	Thor.	“ 16	June 24	July 21
Improved Early White Spined	Thor.	“ 20	July 12	Sept. 21
Improved Long Green Prickly	Greg.	“ 24	“ 15	Aug. 30
Jersey Pickle	Land	“ 20	“ 2	July 29
Landreth's First Early	Land	“ 20	“ 5	Aug. 5
Landreth's White Slicing	Land	“ 20	“ 8	July 30
Large White Bonneuil	Greg.	“ 23	“ 5	Aug. 1
Long Grecian	Thor.	“ 23	“ 6	July 29
Long Green	Thor.	“ 20	“ 7	Aug. 5
Long Green Smooth from Athens	Greg.	“ 21	“ 5	“ 30
Long Green Turkey	Thor.	“ 21	“ 2	“ 4
Meaux Green Pickling (Fr., à cornichons fine de Meaux)	Vil.	“ 20	“ 5	“ 4
Nichols' Medium Green	Thor.	“ 20	“ 4	“ 4
Peerless	Thor.	“ 20	“ 6	“ 4
Russian Netted	Greg.	“ 16	“ 4	July 30
Russian Netted (Fr., brodé de Russia)	Vil.	“ 18	“ 4	“ 30
Short French Pickling	Greg.	“ 22	“ 7	“ 7
Short Prolific Pickle	Land.	“ 16	“ 1	“ 30
Small Early Russian (Fr., de Russie)	Vil.	“ 16	“ 4	“ 19
Small Gherkin	Thor.	July 6	“ 18	....
Snake	Greg.	June 24	....	Sept. 13
Tailby's Hybrid	Thor.	“ 21	July 8	“ 19
West India Gherkin	Greg.	July 8	“ 18	....
White German	Greg.	June 21	“ 7	Aug. 6

SQUASH AND PUMPKIN.

The varieties of squash and pumpkin were planted May 11, two hills of each variety in rows fourteen feet apart, the hills twelve feet apart.

SQUASH.	Seed from	First bloom.	Days from planting.	First fruit ripe.	Days from planting.
Bay State	Raw...	July 2	52	Sept. 24	136
Boston Marrow	Thor..	“ 5	55	“ 14	126
Brazilian Sugar	Thor..	“ 1	51	“ 7	119
Butman	Greg..	“ 6	56	“ 24	136
Butman	Thor..	“ 16	66	“ 24	136
Canada Crookneck	Thor..	“ 5	55	“ 20	132
Dunlap's Early Marrow	Greg..	June 28	48	Aug. 20	101
Early Golden Bush	Thor..	“ 27	47	“ 15	96
Early White Scallop Bush	Thor..	“ 29	49	“ 15	96
Essex Hybrid or Hardshell Turban	Vick..	July 2	52	Sept. 14	126
Extra Early Orange Marrow	Thor..	June 24	44	Aug. 20	101
Green Striped Bergen	Thor..	July 5	55	Sept 1	113
Hubbard	Thor..	“ 6	56	“ 24	136
Landreth's White Turban	Land..	“ 18	68	“ 21	133
Large Winter Crookneck	Greg..	“ 13	63	“ 7	119
Little Cocoanut	Thor..	“ 20	70	“ 7	119
Long Green Summer Crookneck	Land..	“ 21	71	“ 16	128
Low's Premium Hybrid	Thor..	“ 13	63	“ 13	125
Mammoth Chili	Thor..	“ 11	61	“ 24	136
New Egg Plant	Hen ..	“ 9	59	“ 15	127
New French Olive	Thor..	Aug. 5	86	“	....
New Marblehead	Thor..	July 11	61	“ 17	129
New Pineapple	Thor..	“ 11	61	“ 10	122
New Prolific Sugar	Hen ..	“ 9	59	“ 7	119
Ohio	Thor..	Aug. 5	86	“ 15	127
Perfect Gem	Thor..	“ 6	87	“ 7	119
Red China	Thor..	“ 3	84	“ 7	119
Summer Crookneck	Thor..	July 11	61	Aug. 20	101
Turban	Thor..	“ 9	59	Sept. 14	126
Turban or Turk's Cap	Vick...	Aug. 5	86	“ 14	126
Vegetable Marrow	Thor..	July 11	61	“ 7	119
Yokohama (Fr., de Yokohama)	Vil....	Aug. 8	89	“ 21	133

PUMPKIN.	Seed from	First bloom.	Days from planting.	First fruits ripe.	Days from planting.
Black Negro	Thor	July 5	55	Sept. 14	126
Brazilian Sugar	Greg.	“ 2	52	“ 7	119
Bright Red Etampes (Fr., rouge vif, gros d'Etampes)	Vil	“ 6	56	“ 18	130
Bright Red Etampes	Thor	“ 9	59	“ 18	130
Connecticut Field	Thor	June 30	50	Aug. 22	103
Cashaw	Land	July 7	57	Sept. 18	130
Cushaw	Thor	“ 2	52	“ 18	130
Early Sugar	Thor	June 30	50	Aug. 20	101
Green Spanish (Fr., vert d'Espagne)	Vil	July 2	52	Sept. 15	127
Grey Boulogne (Fr., Gris de Boulogne)	Vil	Aug. 5	86	“ 15	127
Improved Mammoth	Thor	July 2	52	“ 18	130
Jumbo	Hen	“ 1	51	Aug. 23	104
Large Cheese	Thor	“ 8	58	“ 23	104
Large Field	Greg.	June 29	49	“ 22	103
Large Tours, or Mammoth	Hen	July 1	51	Sept. 7	119
Large Tours (Fr., de Touraine)	Vil	June 30	50	“ 7	119
Large Yellow Mammoth (Fr., jaune gros)	Vil	July 11	61	“ 7	119
Mammoth	Sib	“ 6	56	....	.....
Mammoth Red Etampes	Greg.	“ 25	75	Sept. 10	122
Michigan Mammoth	Greg.	“ 2	52	Aug. 22	103
Negro, or Nantucket	Greg.	June 30	50	Sept. 7	119
Possum Nose	Greg.	July 27	77	“ 17	129
Tree	Greg.	“ 12	62	“ 15	127

SPINACH.

Seeds from twelve differently named packages of spinach were planted, April 15, in rows twelve feet long and three and one-half feet apart. The following data were noted :

SPINACH.	Seed from	First bloom.	Days from planting.	First ripe seed.	Days from planting.
Bloomsdale	Greg.	May 31	46	June 27	73
Curled Leaved Savoy or Bloomsdale	Thor.	" 31	46	" 27	73
Extra Large Round Leaved	Greg.	" 31	46	" 27	73
Henderson's Norfolk Savoy Leaved	Hen	June 4	50	July 2	78
Large Round Leaf Viroflay	Hen	" 4	50	June 28	74
Large Round Viroflay	Thor.	" 4	50	July 2	78
New Long Standing	Thor.	" 4	50	" 2	78
New Thick Leaved	Hen	" 4	50	" 1	77
New Zealand	Thor.	Sept. 18	156	....	.....
Prickly	Thor.	June 1	47	June 28	74
Round Flanders	Thor.	May 31	46	July 1	77
Round Leaved	Thor.	" 31	46	" 1	77

The Bloomsdale, Greg.; Curled-Leaved or Bloomsdale, Thor.; Extra Large Round-Leaved, Greg., and Henderson's Norfolk Savoy-Leaved, Hen., appeared to be identical.

The Large Round-Leaf Viroflay, Hen.; Large Round Viroflay, Thor.; New Long-Standing, Thor., and New Thick-Leaved, Hen., appeared to be the same.

I could detect no difference in the Round Flanders, Thor., and Round-Leaved, Thor.

The New Zealand, a distinct species, is entirely different from the other varieties in its habit of growth. It remained in edible condition the entire summer. At this date (October 25) it is still in fine condition for eating.

LETTUCE.

Seeds of the following list of lettuces were planted April 23:

LETTUCE.	Seed from.	Of edible size in — days.	Com. to form flower stalk in — days.	Days fit for table use.	First bloom in — days.	First seeds ripe in — days.
Burpee's Silver Ball	Sta.	33	74	41	83	107
Buttercup	Greg.	31	77	46	106	124
Buttercup	Vick.	31	77	46	106	124
Curled leaf	Dam.	38	59	21	87	96
Defiance Summer	Hen.	31	....	....	....	....
Dippe's Emperor	Sta.	39	53	14	70	87
Egg Small Early Solid	Ben.	31	57	26	85	96
Emperor Frame Cabbage	Greg.	39	53	14	74	94
Finest Moss Curled	Dam.	39	47	8	67	85
Forcing Emperor Earliest Yellow	Ben.	39	50	11	67	87
Green Fat	Will.	36	70	34	88	109
Hanson	Greg.	34	78	44	92	106
Imperial Select Cabbage	Land.	29	57	28	74	95
Improved Hanson	Thor.	31	78	47	91	106
Large Brown Coblentz	Dam.	31	72	41	88	104
Large Egg Frame	Dam.	32	68	36	90	103
Perpignan	Dam.	31	72	41	91	105
Prize Market	Sib.	31	74	43	91	106
Sibley's Genesee	Sib.	29	77	48	104	115

The Buttercup lettuce was entirely different from any variety heretofore grown at the Station.

Sibley's Genesee was identical with the Neapolitan.

There was but one plant of the Defiance Summer, Hen.; consequently the data concerning this variety are necessarily incomplete.

CABBAGE.

In the following list of cabbage the products from the large and small seed of twelve of the varieties are given, together with other data, in the following table:

TABLE—CABBAGE.

CABBAGE.	LARGE SEED.							SMALL SEED.					
	Seed from	First head formed.	Days from planting.	Number of plants.	Number of heads form'd	Av. diameter in inches.	Av. weight of heads in ozs.	First head formed.	Days from planting.	Number of plants.	Number of heads form'd	Av. diameter in inches.	Av. weight in ounces.
Acme Drumhead Savoy	Alb.	Oct. 20	155	9	6	$8\frac{2}{3}$	61	Oct. 20	155	11	10	7 4-5	57
Acme Flat Dutch	Alb.	Oct. 5	140	11	9	$9\frac{1}{2}$	89	Oct. 5	140	11	10	$8\frac{1}{2}$	66
Acme Red Drumhead	Alb.	Oct. 15	150	10	4	$5\frac{1}{2}$	33	Oct. 15	150	11	4	$5\frac{1}{2}$	33
Early Drumhead	Liv.	Sept. 21	126	12	11	8	88	Sept. 26	131	9	8	$8\frac{3}{4}$	96
Early Mammoth Bulgarian	Thor	Oct. 5	140	12	12	8	70	Oct. 5	140	12	12	$8\frac{3}{4}$	69
Early Paris Market	Thor	Sept. 23	128	11	11	$7\frac{1}{2}$	72	....	....	..	..	....	...
Express (extra early)	Vil.	Sept. 3	108	12	12	$6\frac{1}{2}$	63	Sept. 8	113	11	11	6	50
Extra Early Midsummer St. Jean (Fr., de Milan très hâtif de la St. Jean)	Vil.	Sept. 20	125	10	10	7 2–5	57	....	....	1	..	....	...
Green Mountain	Alb.	Oct. 8	143	11	9	9 4–9	71	Oct. 8	143	10	6	9	83
Housman's Flat Dutch	Alex.	Oct. 3	138	12	7	9	78	Oct. 6	171	11	5	9	78
Montreal Market	Alex.	Oct. 1	136	12	8	9	80	....	....	..	..	....	...
Reedland Early Drumhead	Land.	Sept. 20	125	12	12	$9\frac{1}{3}$	103	Sept. 20	125	12	12	9	99
Renne's Early (Fr., hâtif de Renne's)	Vil.	Sept. 20	125	12	9	7	61	Sept. 20	125	11	8	$6\frac{3}{8}$	54
Stein's Early Flat Dutch	Alb.	Oct. 1	136	12	10	$9\frac{1}{2}$	85	Oct. 1	136	12	10	9	81
Strang's Very Early	Alb.	Sept. 21	126	12	10	9 7–10	97	Sept. 28	133	10	10	9	93
Winter	Liv.	Oct. 18	153	6	3	6	33	....	....	..	..	....	...

In nearly every planting, the average diameter and average weight of the heads from large seed were greater than from the small seed.

Tomato.

Seeds of the following list of tomatoes were planted in boxes and placed in the greenhouse March 11; when of proper size the plants were potted in three-inch pots, from which four plants of each name were transplanted to the garden May 20, in rows seven feet apart, the plants three feet apart in the row:

TOMATO.

TOMATO.	Seed from	First fruit ripe.	Days from planting.	Ten fruits ripe.	Days from planting.
Acme	Thor..	July 25	136	Aug. 2	144
Alpha	Thor.	“ 16	127	July 26	137
Arlington	Greg..	Aug. 2	144	Aug. 5	147
Autocrat	Sib. ..	July 22	133	“ 6	148
Bermuda (Extra Early)	Land..	“ 26	137	“ 1	143
Boston Market	Greg..	“ 26	137	“ 1	143
Bunker Hill	Bliss..	“ 26	137	“ 2	144
Cardinal	Thor..	“ 25	136	“ 7	149
Conqueror	Thor..	“ 18	129	July 23	134
Cook’s Favorite	Land..	“ 23	134	“ 29	140
Criterion	Greg..	“ 28	139	Aug. 4	146
Dwarf Orangefield	Sib. ..	Aug. 10	174	“ 28	192
Early Advance	Thor..	July 26	137	July 28	139
Early Jersey (Extra Early)	Land..	“ 23	134	Aug. 5	147
Early King Humbert	Thor..	“ 23	134	July 26	137
Early Richmond	Land..	“ 24	135	Aug. 2	144
Early Smooth Red	Vick..	“ 26	137	July 28	139
Essex Hybrid	Thor..	“ 23	134	“ 27	138
Essex Round Red Smooth	Greg..	“ 21	132	“ 27	138
Extra Early or Cluster	Land..	“ 25	136	“ 31	142
Faultless	Greg..	“ 26	137	“ 29	140
Fejee Improved	Greg..	“ 25	136	Aug. 6	148
Fulton Market	Greg..	“ 22	133	July 27	138
Gen. Grant	Vick..	“ 18	129	Aug. 1	143
Golden Queen (Fr., jaune grosse lisse)	Vil....	Aug. 2	144	“ 11	153
Golden Queen	Thor..	July 29	140	“ 2	144
Golden Trophy	Land..	“ 30	141	“ 3	145
Green Gage	Thor..	“ 31	142	“ 3	145
Hathaway’s Excelsior	Vick..	“ 18	129	“ 2	144
Hovey	Thor..	Aug. 1	143	“ 10	152
Hubbard’s Curled Leaf	Thor..	July 21	132	July 27	138
Hundred Day	Thor..	“ 18	129	“ 24	135
Improved Large Yellow	Thor..	Aug. 9	151	Aug. 15	157
Improved Mayflower	D.of A.	July 22	133	“ 4	146
Improved Queen	Thor..	“ 26	137	“ 4	146
Island Beauty	Hen ..	“ 27	138	“ 2	144
Ivory Ball	Land..	“ 28	139	“ 2	144
Large Round Red Smooth	Greg..	“ 29	140	“ 3	145
Large Smooth Red	Thor..	“ 29	140	“ 6	148
Large Yellow	Thor..	“ 26	137	“ 2	144
Little Gem	Greg..	“ 16	127	July 19	124
Livingston’s Beauty	Liv. ..	“ 23	134	Aug. 13	155
“ “	Thor..	“ 23	134	“ 3	145
Livingston’s Favorite	Liv. ..	“ 25	136	“ 3	145
“ “	Thor..	“ 24	135	“ 2	144
Livingston’s Perfection	Liv. ..	“ 23	134	“ 2	144
“ “	Thor..	“ 27	138	“ 2	144
“Maule’s $1,600 Strain”	Maule	Aug. 13	121	Sept. 1	139
Mayflower Sport	Bliss..	“ 1	143	Aug. 7	149
Mayflower	Vick..	July 25	136	“ 3	145
Mikado	Thor..	Aug. 3	145	“ 9	151
New Bronzed-Leaved	Greg..	July 23	134	“ 6	148
New Currant	Thor..	“ 8	119	July 10	121
New Jersey	Thor..	“ 27	138	Aug. 15	157
New Paragon	Thor..	“ 28	139	“ 12	154

TABLE — TOMATO — *(Continued).*

TOMATO.	Seed from	First fruit ripe.	Days from planting.	Ten fruits ripe.	Days from planting.
New Red Apple	Greg.	July 23	134	Aug. 4	146
New White Apple	Thor.	" 30	141	" 10	152
Optimus	Thor.	" 27	138	" 6	148
Peach	Land.	Aug. 13	155	" 18	160
Pear-shaped	Thor.	July 21	132	July 30	141
Potato Leaf	Sta	" 27	138	Aug. 10	152
President Garfield	Sib.	Aug. 3	145	" 13	155
Queen	Hen	July 27	138	" 7	149
Rawson's Puritan	Raw	" 22	133	" 4	146
Red Cherry	Thor.	" 11	122	July 14	125
Rochester	Sib.	" 29	140	Aug. 15	157
Rochester Favorite	Greg.	Aug. 5	147	" 15	157
Station	Sta	July 6	117	July 16	127
Tilden's New	Greg.	" 23	134	July 31	142
Trophy	Thor.	Aug. 3	145	Aug. 12	154
Turner's Hybrid	Greg.	" 17	159	" 27	169
Yellow Cherry	Thor.	July 6	117	July 12	123
Yellow Fig	Greg.	" 23	134	" 30	141
Yellow Plum	Thor.	" 23	134	" 28	139
Yellow Victor	Greg.	" 26	137	Aug. 1	143

In the above table the Dwarf Orangefield, and Maule's $1,600 Strain, were planted March 31 and April 14, respectively.

The Station variety matured the first fruit, and also the first ten fruits of any, except the Cherry and Currant, the fruit of which are too small for table use.

PEA.

The following list of peas was planted April 15 in rows twelve feet long, the rows three and one-half feet apart. The names Italicised are wrinkled varieties.

TABLE.— PEA.

PEA.	Seed from	First bloom.	Days from planting.	Of edible size.	Days from planting.	Days fit for table use.	First ripe seeds.	Days from planting.	Last ripe seeds.	Days from planting.	Number of pods per 100 plants.	Number of peas in 100 average pods.
Advance	D. of A.	May 23	38	June 8	54	17	June 23	69	July 5	81	579	520
Alaska	Cleve	“ 23	38	“ 8	54	17	“ 23	69	“ 5	81	481	549
Alaska	D. of A	“ 23	38	“ 8	54	17	“ 23	69	“ 5	81	522	583
Laxton's Earliest of All	Thor	“ 23	38	“ 8	54	17	“ 23	69	“ 5	81	529	554
American Beauty	Alex	June 10	56	“ 30	76	21	July 12	88	“ 28	104	......	.....
American Champion	Hen	“ 6	52	“ 21	67	24	“ 7	83	“ 20	96	1,018	642
Carter's Anticipation	Raw	“ 6	52	“ 29	75	20	“ 7	83	“ 29	105	......	.....
Carter's Lightning	Raw	May 23	38	“ 8	54	17	June 23	69	“ 5	81	564	548
Delicious	Greg.	June 8	54	“ 30	76	11	July 7	83	“ 29	105	1,292	475
King of the Dwarfs	Greg.	May 25	40	“ 11	57	16	June 27	73	“ 8	84	490	504
Lightning	Greg.	“ 24	39	“ 9	55	18	“ 23	69	“ 5	81	448	537
Rawson's Clipper	Raw	“ 24	39	“ 8	54	19	“ 23	69	“ 5	81	438	593
Sugar or Edible Podded (Fr., St. Desiret Melting)	Vil	June 6	52	“ 21	67	21	July 5	81	“ 18	94	735	615
Vick's King of the Dwarfs	Vick	May 25	40	“ 11	57	16	June 27	73	“ 12	88	518	493

The following varieties were edible on the same day, and appear to be identical: Advance, D. of A., Alaska, Cleveland and Dept. of Agriculture, Laxton's Earliest of All, Thor., Rawson's Clipper, Raw.

Carter's Lightning, Raw., was also edible on the same day ; Lightning, Greg., was edible one day later; the color of the seed appears to be the only difference between these and the first named varieties. The seed of the first-named varieties is blue and of the latter white.

BEAN.

Seed of the list of beans in the following table were planted May 13. The bush beans were planted in rows twelve feet long, and three and one-half feet apart; the seeds were placed three inches apart in the rows. The climbing varieties were planted in hills three feet apart in the row, and a pole was placed at each hill to support the vines:

	Seed from	First bloom.	Days from planting.	Of edible size.	Days from planting.	First seed ripe.	Days from planting.
BUSH BEANS.							
Ansley's Scarlet Flageolet Wax	Ans ..	June 22	40	July 5	53	Aug. 4	85
Black-Eyed Wax	Greg..	“ 21	39	“ 7	55	July 30	78
Early Succotash	Sib....	“ 27	45	“ 8	56	Aug. 3	84
Improved Red Valentine..	“	“ 5	53	“ 11	59	“ 11	92
Landreth's Scarlet	Land..	“ 24	42	“ 8	56	“ 9	90
Landreth's Violet	“	“ 27	45	“ 8	56	“ 9	90
Low's Champion	Sib....	“ 24	42	“ 8	56	“ 12	93
Marblehead Dwf. Horticultural	Thor..	“ 27	45	“ 8	56	“ 3	84
Phareolis radiata or Mungo	D. of A.	Aug. 25	104	Oct. 10	150	Oct. 25	165
Wardwell's New Kidney Wax	“	“ 21	39	“ 6	54	July 30	78
Wax Date	Sib....	“ 24	42	“ 6	54	“ 27	75
POLE BEANS.							
Brockton	Greg..	July 5	53	July 20	68	Aug. 20	101
Dreer's Gold'n Cluster Wax	Thor..	Aug. 11	90	Aug. 23	102	Sept. 20	130
Early Golden Cluster Wax.	Evt...	“ 11	90	“ 18	97	“ 20	130
Early Golden Cluster Wax.	Hen ..	“ 11	90	“ 15	94	“ 20	130
Early Maine, or Essex prolific	Sib....	July 5	53	July 16	64	Sept. 17	127
Garden Treasure	Evt...	Aug. 11	90	Sept. 1	111	“ 25	135
Thompson's Prolific, or Kentucky Wonder	Sib....	July 5	53	July 21	69	Aug. 15	96

Ansley's Scarlet Flageolet Wax produced pods of edible size a few days earlier than any other variety in the list.

There was very little difference in the time of edible maturity of the different varieties of bush beans.

The Brockton pole bean appears to be a desirable variety. It was productive, and the large green pods splashed with bright crimson make it a desirable market variety.

NOTES ON FRUIT.

STRAWBERRY.—A TEST OF YIELD.

Plants of the following list of strawberries were set out in the spring of 1885, with three exceptions. Two rows of each variety were planted, the rows fifty feet long and four feet apart, and twenty-five plants in each row. The yield of the rows grown in hills, for the season of 1886 was given in the report for that year. The matted rows were from three to five feet in width and thickly filled with plants. The runners were cut off and not allowed to form plants, in the row grown in hills.

The yields of the rows grown in hills are computed for 25 plants or 50 feet of row; the yields from the matted rows are computed for the same length of row. The fruit picked from ten feet in length of the matted row was used in computing the yield. The average number of berries per ounce for each row, also the yields in quarts as computed, allowing twenty ounces of fruit per quart, together with other data, are given in the table.

TABLE—STRAWBERRY.

STRAWBERRIES.	Bloomed.	First berries ripe.	Last berries ripe.	Number of berries produced by matted row.	Number of berries produced by row in hills.	Weight of berries from matted row in ounces.	Weight of berries from row in hills, in ounces.	Yield of matted row in quarts.	Yield of hill row in quarts.	Average number of berries per ounce from matted row.	Average number of berries per ounce from hill row.	Number of days in bearing.
Covill's Early	May 13	June 6	June 29	7,195	......	537½	......	26.8	....	13.3	......	23
Bidwell	May 13	June 13	July 7	2,090	658	193⅛	49⅛	9.6	2.4	10.2	13.4	24
Chas. Downing	May 13	June 11	July 6	4,995	772	554⅜	77¾	27.5	3.8	9.	9.9	25
Cornelia	May 20	June 18	July 13	4,680	503	573¾	79⅓	28.5	3.9	8.2	6.3	25
Daisy Miller	May 17	June 10	July 8	4,145	633	459⅜	72	22.9	3.6	9.	8.8	28
Garretson	May 16	June 7	July 5	5,380	776	617⅓	91⅓	30.8	4.5	8.7	8.5	28
James Vick	May 14	June 14	July 9	6,500	1,418	571⅞	133 5-6	28.5	6.6	11.3	10.5	25
Jersey Queen	May 20	June 18	July 14	3,010	410	542½	76	27.1	3.8	5.5	5.4	26
Jucunda	May 14	June 15	July 8	1,120	341	72½	18½	3.6	.9	14.4	18.4	23
Jumbo	May 12	June 17	July 9	6,320	892	1,026⅞	138	51.3	6.9	6.1	6.4	32
Kentucky	May 16	June 15	July 13	5,115	1,106	575	127	28.7	6.3	8.9	8.7	28
Legal Tender	May 14	June 15	July 8	7,300	781	672½	70	33.6	3.5	10.8	11.1	23
Lennig's White	May 13	June 11	July 16	545	179	48⅛	18	2.4	.9	11.3	10	35
Longfellow	May 16	June 14	July 14	2,580	417	316¼	63⅝	15.8	3.1	8.1	6.5	30
Manchester	May 14	June 11	July 12	7,020	890	778¾	92⅜	38.9	4.6	9	9.6	31
Manchester (duplicate)	May 16	June 13	July 11	5,245	801	666¼	74⅓	33.3	3.7	7.8	10.8	28
May King	May 13	June 11	July 7	6,260	1,086	627⅓	102	31.3	5.1	9.9	10.6	26
Mt. Vernon	May 17	June 15	July 9	6,750	1,043	1,046¼	115 7-9	52.3	5.7	6.4	9	24
Mrs. Garfield	May 12	June 15	July 9	......	1,004	......	133 5-6	....	6.6	......	7.4	24
Ontario	May 16	June 8	July 9	......	364	......	54	....	2.7	......	6.8	31
Parry	May 14	June 9	July 10	2,865	584	516⅛	91¾	25.8	4.5	5.6	6.5	31
Piper's Seedling	May 12	June 15	July 8	6,640	1,254	638⅛	109	31.9	5.4	10.	11.5	23
Primo	May 14	June 15	July 9	6,015	1,107	756⅞	145	37.8	7.2	7.9	7.5	24
Prince of Berries	May 20	June 15	July 9	4,495	489	585	55½	29.2	2.7	7.7	8.8	24
Sharpless	May 16	June 14	July 2	2,885	455	533¾	74⅔	26.6	3.7	5.4	6	18
Wilson	May 12	June 7	July 1	7,635	1,803	474⅜	130	23.7	6.5	16.1	13.9	24
Woodruff No. 1	May 12	June 14	July 13	7,920	1,421	846¼	176	42.3	8.8	9.4	8	29

It appears that Covill's Early was the earliest in this list, and Cornelia and Jersey Queen the latest to ripen.

The Lennig's White and Jumbo remained in bearing the greatest, and the Sharpless the least number of days.

The greatest number of berries was obtained from the matted row of the Mt. Vernon, the least from Lennig's White.

The hill row producing the greatest number of berries was the Wilson, the least Lennig's White; Woodruff No. 1 the greatest weight of fruit, and Lennig's White the least weight.

The average number of berries per ounce from the matted rows was 9.2, from hill rows 8.1.

Average yield per matted row 22 quarts, per hill row 7.3 quarts.

Covill's Early. — Plant dwarfish, vigorous; leaves dark glaucous green; fruit medium size, somewhat resembles the Wilson in form, dull reddish color; seeds light yellow, very prominent, giving the berry a rather uninviting appearance; flesh very firm, bright scarlet color; flavor only fair; fruit stalks short; season early. Slightly blighted.

Two new varieties, the Ontario and an unnamed variety received from R. S. Johnston, Shortsville, N. Y., were planted October 1, 1886. The plant and fruit of the Ontario resemble the Sharpless; the fruit is perhaps a little more uniform in shape.

The unnamed variety was very late; June 30 the plants were still in bloom, first ripe fruit June 24, last fruit ripe July 16; fruit medium size, pale dull red color, somewhat resembling the Cornelia; flesh very soft, flavor very sweet and delicious; does not appear to be productive; plants very dwarf; pistillate blossoms.

Excelsior.—A variety received from J. M. Buechley; plants of vigorous growth; fruit medium to large, dark scarlet color, colors up very uniformly, roundish oblong shape, not pointed; flavor good; fairly productive. Appears quite promising.

Miami. Plants set August 20, 1886, received from J. D. Kruschke with the following description: "Plant hardy; fruit large, bright red, solid, good flavor, late; flowers nearly perfect, easily fertilized." The plants produced a few flowers, but no fruit.

The fruit of the James Vick strawberry, like the Wilson, is not fully ripe when it first colors. The fruit should be allowed to become fully ripened before picking, and the flavor will be delicious.

RASPBERRY.

The following list of raspberries were set out in the spring of 1885, with the exception of those printed in italics, which were set in the spring of 1886. The dates of first bloom, first and last ripe fruits, and the weight of 100 berries of each variety, with a few exceptions, are given in the following table:

RASPBERRY.	First bloom.	First ripe fruit.	Last ripe fruit.	Weight of 100 berries in grams.
Brandywine	June 6	July 12	Aug. 8	124.9
Caroline	May 21	June 29	“ 12	123.4
Carpenter's Seedling	June 1	July 4	“ 1	127.2
Crimson Beauty	“ 7	“ 6	“ 1	125.7
Cuthbert	“ 6	“ 12	Aug. 12	206.2
Erie	“ 3	“ 2	....	.....
Gregg	May 31	“ 9	July 25	130.2
Hansell	“ 25	June 27	“ 27	172
Johnson's Sweet	“ 31	July 5	“ 23	.....
Lost Rubies	June 6	“ 11	Aug. 1	162.2
Mammoth Cluster	“ 1	“ 6	July 25	.....
Marlboro	“ 3	“ 5	Aug. 6	248
Meredith Queen	“ 15	“ 16	“ 1	.....
Miller's Woodland	“ 3	“ 4	“ 6	209.8
Montclair	“ 2	June 30	“ 3	164.4
Nemaha	May 31	July 6	July 22	.....
Ohio	“ 30	“ 6	“ 23	90
Orange	June 1	June 30	“ 30	160.4
Philadelphia	“ 2	July 6	“ 27	99.2
Reder	“ 4	“ 4	“ 31	177
Schaffer	“ 11	“ 9	Aug. 13	.....
Souhegan	May 30	“ 5	July 23	.....
Superb	June 4	“ 6	Aug. 3	.....
Turner	“ 3	“ 4	July 27	163.2
White Seedling	May 30	June 30	“ 25	187.5

Nearly all the plants of the following varieties were destroyed by winter-killing or otherwise: Johnson's Sweet, Mammoth Cluster, Nemaha, Schaffer, Souhegan.

The Hansell ripened the first berries; Meredith Queen was the last to ripen; the Caroline remained in bearing the longest.

Meredith Queen.— Berries medium size, pale red color, very soft, poor flavor; suckers badly, canes rather weak, not productive.

Erie.— Berries medium size, dark purple, resembles the Philadelphia in color; flesh soft, good flavor; canes strong and vigorous; very productive, belongs to the ever-bearing class; blossoms and ripe fruit are upon the canes at the present date (October 25).

Carpenter's Seedling.— Closely resembles Beebe's Golden, early, vigorous grower, does not appear to be of any value.

BLACKBERRY.

In the following list of blackberries the dates of first bloom, first and last ripe fruits were as follows:

	First bloom.	First ripe fruits.	Last ripe fruits.
BLACKBERRY.			
Agawam	May 24	July 18	Aug. 15
Brunton's Early	June 8	“ 15	July 27
Crystal White	“ 12	Aug. 8	....
Dorchester	May 31	July 16	Sept. 1
Early Cluster	“ 31	“ 13	Aug. 15
Early Harvest	June 7	“ 11	July 23
Kittatinny	“ 3	“ 23	Sept. 1
Newman's Thornless	“ 4	“ 25	Aug. 9
New Rochelle	May 31	“ 25	“ 12
Snyder	“ 31	“ 18	Sept. 1
Stayman's Early	“ 23	“ 16	July 26
Stone's Hardy	“ 26	“ 23	Sept. 2
Taylor's Prolific	“ 28	“ 22	“ 2
Wilson's Early	June 3	“ 16	Aug. 8
Wilson's Junior	“ 3	“ 18	“ 1
DEWBERRY.			
Bartell's	May 24	“ 9	....
Lucretia	“ 26	“ 9	....
Mammoth	“ 26	“ 11	....

Agawam.— This variety produced very good fruit this season. I consider the flavor the best of any variety in the above list; was not as productive as Taylor's Prolific or Stone's Hardy. The tips of last year's growth were slightly winter-killed. It has made a very strong growth this season.

Early Cluster.— Berries smaller than those of the Agawam, poor flavor; moderately productive; made fair growth of new wood; tips were slightly winter-killed.

Early Harvest.— About one-half of last season's growth winter-killed; made a fair growth of new wood, but produced very little fruit; does not appear to be valuable here.

Stayman's Early.— Has done very poorly, winter-killed badly; fruit small and of very poor quality. One plant of this variety is very badly affected with the rust.

Stone's Hardy.— Promises well; tips slightly winter-killed; has made a good growth of new wood; fruit somewhat smaller than that of the Agawam; fair flavor; very productive.

Taylor's Prolific.— Tips slightly winter-killed; has made very vigorous growth of new wood; the most productive variety in the list; berries large and of fair flavor.

Wilson's Early.— Appears to be of no value here, as it winter-killed badly and has made very poor growth of new wood. Produced a few small berries.

Wilson's Junior— Is of no more value than the Wilson's Early.

There appears to be no difference in the Bartell and the Mammoth dewberries; both have made a very vigorous growth of new wood, many of the branches being from 10 to 15 feet in length. A few berries were produced, some of which were very large; the fruits were sour and of poor flavor.

Lucretia.—The plants were set last spring, and bore a few small berries. The new growth is from 3 to 4 feet in length.

The trailing habit of growth of the dewberry and the numerous sharp spines render it very difficult to gather the fruit.

CURRANT AND GOOSEBERRY.

The following varieties of currant were planted in the spring of 1884 except Fay's Prolific, which was planted in 1883. The data as noted appear in the following table:

CURRANT.	First bloom.	First fruits ripe.	Last fruits ripe.
Cherry	May 4	June 22	July 5
Fay's Prolific	" 4	" 22	" 5
Glorie des Sablons	" 7	" 27	" 7
London Red	" 6	" 27	" 7
Prince Albert	" 6	July 2	" 12
Red Dutch	" 5	June 27	" 5
Short Bunched Red	" 8	" 27	" 7
Versailles	" 4	" 23	" 7
Victoria	" 6	" 25	" 7
White Dutch	" 5	" 25	" 5
White Grape	" 5	" 22	" 5

The black currants and gooseberries in the following tables were planted in the spring of 1882. The dates of the first blossom, first and last ripe fruits were as follows:

BLACK CURRANT.	First bloom.	First fruits ripe.	Last fruits ripe.
Baldwin's Black	May 10	July 8	July 25
Black English	" 10	June 29	" 25
Black Naples	" 10	" 30	" 25
Lee's Black Prolific	" 10	" 30	Aug. 1
Ogden's Black Grape	" 10	" 29	" 1
Missouri Large Fruited	....	....	....
Missouri Sweet Fruited	....	....	....

GOOSEBERRY.	First bloom.	First fruits ripe.	Last fruits ripe.
Downing	May 5	July 14	Aug. 1
Houghton	" 8	" 14	" 1
Industry	" 6	" 8	July 25
Mountain Seedling	" 9	" 25	Aug. 5
Pale Red	" 8	" 13	" 1
Smith's	" 5	" 13	July 25
Wellington's Glory	" 9	" 18	" 28

The Industry gooseberry was badly affected with the mildew this season, so much so that very few fruits ripened.

Mountain Seedling and Wellington's Glory were somewhat affected but much less than the Industry. The other varieties of gooseberries showed but little if any signs of mildew.

APPLE.

The following data were noted of the varieties in bearing this season :

APPLE.	First leaves appeared.	First flowers opened.	First ripe fruits.	First leaves falling.	Last leaves falling.
Aunt Ginnie	May 4	May 16	Sept. 20	Oct. 5	Dec. 6
Ben Davis	" 4	" 13	Oct. 1	" 8	Nov. 25
Brownlee's Russet	" 9	" 14	" 1	" 10	Dec. 9
Carolina June	" 5	" 14	July 23	" 5	Nov. 25
Cox's Pomona	" 6	" 14	Sept. 5	" 3	" 25
Early Harvest	" 4	" 13	July 20	" 5	" 19
Jefferis	" 4	" 11	Aug. 20	" 5	Dec. 2
Jersey Sweeting	" 4	" 13	" 20	" 5	" 6
Keswick Codlin	" 4	" 11	Sept. 5	" 3	" 6
Lord Suffield	" 4	" 11	Aug. 25	" 3	Nov. 18
Maiden's Blush	" 6	" 16	Sept. 25	" 5	" 24
Primate	" 4	" 11	July 20	" 3	" 25
Red Transparent	" 3	" 11	" 27	" 8	" 21
Rome Beauty	" 6	" 16	Sept. 20	" 5	Dec. 9
Small's Admirable	" 6	" 13	" 6	" 4	" 9
Tetofsky	" 8	" 13	July 20	" 1	Nov. 10
Wagener	" 5	" 13	Sept. 25	" 28	Dec. 9
William's Favorite	" 6	" 13	Aug. 1	" 5	Nov. 22

GRAPES.

There are fifty-seven varieties of grapes growing at the Station, twenty-four of which bore fruit the past season.

The following data were noted:

GRAPES.	First leav's appeared.	First flowers opened.	First ripe fruits.	First leav's falling.	Last leaves falling.
Amber Queen	May 10	June 6	Sept. 17	Oct. 8	Oct. 26
Barry	“ 9	“ 7	“ 13	“ 3	Nov. 2
Brighton	“ 9	“ 10	“ 3	“ 5	“ 2
Burnet	“ 10	“ 10	“ 13	“ 8	Oct. 26
Catawba	“ 11	“ 12	Oct. 3	“ 10	“ 27
Champion	“ 9	“ 22	Aug. 29	“ 3	Nov. 2
Duchesse	“ 10	“ 13	Sept. 21	“ 8	Oct. 26
Early Victor	“ 13	“ 14	“ 26	“ 10	Nov. 2
Francis B. Hayes	“ 10	“ 10	“ 4	“ 8	Oct. 26
Highland	“ 11	“ 13	“ 24	“ 8	“ 26
Iona	“ 13	“ 13	“ 27	“ 8	“ 27
Jefferson	“ 11	“ 11	Oct. 11	“ 18	Nov. 12
Jessica	“ 11	“ 11	Sept. 13	“ 10	“ 12
Lady Washington	“ 10	“ 10	“ 28	“ 8	Oct. 26
Lindley	“ 11	“ 10	“ 27	“ 5	“ 27
Marvin's Centennial	“ 11	“ 10	“ 28	“ 11	“ 27
Monroe	“ 10	“ 8	“ 13	“ 8	“ 26
Moore's Early	“ 10	“ 7	“ 3	“ 3	“ 26
Rochester	“ 12	“ 7	“ 10	“ 3	Nov. 12
Salem	“ 7	“ 6	“ 5	“ 3	Oct. 26
Seedling (Jas. M. Paul)	“ 9	“ 8	“ 1	“ 3	“ 26
Senasque	“ 11	“ 13	“ 13	“ 8	“ 27
Vergennes	“ 13	“ 8	“ 19	“ 8	“ 27
Wilder	“ 9	“ 7	“ 21	“ 3	“ 26
Worden	“ 11	“ 10	“ 17	“ 10	“ 28

The season has been favorable for the ripening of even the latest varieties.

The seedling received from James M. Paul, North Adams, Mass., appears to be a promising early white variety.

I think the quality of the Amber Queen was much inferior this season to what it was last; the bunches also were smaller and less compact.

The Champion was the earliest to ripen; the fruit is of inferior quality.

The Jefferson was the latest to ripen; the fruit of this variety was sweet and of excellent quality.

The fruit of the Senasque, Early Victor and Duchesse cracked quite badly.

NOTES ON MILDEW AND ROT.

Marvin's Centennial and Senasque were most affected with the white mildew, *Unicula spiralis.*

Burnet, Catawba, Iona and Lady Washington were considerably affected.

Amber Queen, Barry, Brighton, Champion, Hayes, Monroe and Salem were very slightly mildewed.

The fruit of Senasque, Monroe, and Rochester was considerably affected with rot after the berries had attained full size and were nearly ripe. Lady Washington and Duchesse were very slightly affected.

The appearance of the diseased fruits did not answer to the description of the rot as described by Prof. Scribner.*

It differed from the description in that the skin of each berry was ruptured. Specimens of the diseased fruit were forwarded to Prof. Scribner, and the assistant in charge, Mr. B. F. Galloway, succeeded in finding the mycelium of *peronospora viticola* ("brown rot") in some of the berries, although there was no external evidence of the presence of the fungus.

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* Report on the Fungus Diseases of the Grape Vine by F. Lamson Scribner, B. Sc., Bulletin No. 11, D. of A., 1886.

REPORT OF THE BOTANIST.*

The present report covers the eight months of 1887 from January to August, inclusive. A few series of observations have been extended beyond this time and completed through the kindness of Mr. E. S. Goff and Mr. M. H. Beckwith, of the horticultural department of the Station. The report embraces a study of the potato scab and the conditions which influence its development; further discoveries in the life history of the plum-leaf fungus; the use of sulphide of potassium in the treatment of several plant diseases; notes upon apple and pear scab; disease of clover-leaf weevil, peach curl, gooseberry mildew; the constancy of leaf characters of the wild dandelion under cultivation, and a form of constant temperature apparatus for the germination of seeds at their upper limit of growth.

The weed statistics are continued regarding the number and kind of weeds that grow on one-twentieth of an acre during a season; besides this the number of germinations from a square foot of soil, taken to the depth of three inches or less, are given, and some items relating to the germination of weed seeds.

A convenient summary of the subject-matter of the four reports of the botanist to the Station, the dates and form of publication of these reports, and an index to them complete the present report. The order of topics is as follows:

- Potato scab.
- Plum-leaf fungus.
- Sulphide of potassium as a fungicide.
- Fragmentary notes:
  - Scab and rust of apples and pears.
  - Disease of the clover-leaf weevil.
  - Peach curl.
  - Gooseberry mildew.
  - Constancy of characters in the wild dandelion.
  - Constant temperature apparatus.
- Weed statistics:
  - Weeds on one-twentieth of an acre.
  - Weeds from one square foot of soil.
  - Germination of seeds.

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*J. C. Arthur.

Summary of botanist's reports for 1884-7.
Publication of reports for 1884-7.
Index to botanist's reports for 1884-7.

THE POTATO SCAB.

The potato crop is much deteriorated each season by roughened spots on the surface of the tubers, varying from shallow to more or less deep-seated concavities filled with effete matter. This affection is so common and uniform in its features that every reader will at once recognize it under the name of scab.

The scab makes its appearance upon the tubers in the hill when they are no larger than hazel-nuts or even smaller. It first shows as irregular, superficial, very small spots, which lose the pale, smooth look of the healthy skin, and turn brown and rough. These spots continue to increase in diameter and depth until the potatoes are removed from the ground at harvest time. Other centers of scab arise as the tubers grow, and when sufficiently numerous coalesce, and in extreme cases envelope the whole tuber. As the spots enlarge they do so at the expense of the tissues of the potato lying beneath them, which pass over into a spongy brown substance filling the cavity of the scabbed spot. The change in the tissues is not a truly putrefactive one, but a gradual loss of life in the cells of a well-defined area, followed by a very slow decomposition. Beneath the spots the substance of the tuber remains unaffected.

The cause of potato scab has been long in dispute. The explanations which have recently found most favor in American journals, ascribe it on one hand to the attack of parasitic fungi, and on the other hand to the depredations of worms, grubs, myriapods, or other small animals in the soil. It is not the present purpose of the writer to attempt a refutation of either view, but attention is called to the significant fact that mycologists and entomologists who have looked into the matter find no good grounds for such explanations. One of the strong arguments, moreover, against these views, although by no means an unanswerable one, is that no particular kind of fungus or small animal, in truth no fungus or animal at all, can be found to invariably accompany the injury at any particular stage of its development.

A study of the minute structure and growth of the spots throws some light upon the matter. The potato tuber is enveloped by a thin skin, readily separable as a semi-transparent delicate membrane when the tuber is cooked by boiling. This membrane is nearly or quite impervious to moisture and gases. It thus protects the interior tissues against harmful substances in solution in the soil, and also keeps them from drying out, whether the tubers are in or out of the ground. This surface membrane, or skin, is made up of several layers of regular flat cells, fitting together so closely as to leave no spaces between the corners, and without a deposit of starch as in the other tissues of the tuber. Chemical tests show that the substance of the cell-walls is different from that of the walls of the other tissues; in short the skin of the potato is a thin layer of delicate cork. Figure 1 shows a magnified section of the skin and some of the tissues just beneath it.

A microscopic examination of scab spots of different ages discloses the fact that they are produced by the outer cells of the corky layer of the skin dying, and separating to form the loose brown dead matter which contributes so much to the rough appearance of the diseased tubers. Long soaking of scabbed potatoes permits this dead part to be completely washed away, leaving the corky skin beneath. As the outer cells of the skin die at the scabbed spots, new ones are formed within at the expense of the other tissues immediately beneath. Thus the scab eats its way deeper and deeper into the tuber.

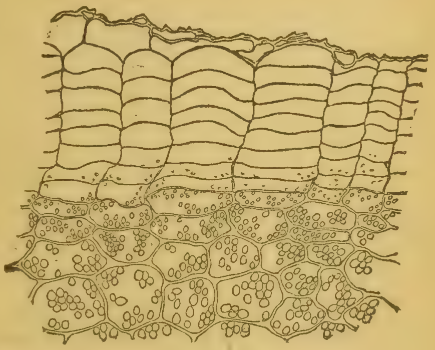

FIGURE 1.

Transverse section from a half-grown tuber, showing at the upper part of the figure the collapsed and broken cells from the surface of the potato, through the middle the broad band of rectangular cork cells forming the skin of the potato, and at the lower part the starch-bearing cells like those which form the larger part of the tuber, Magnified 125 diameters. Original.

It is scarcely possible to say at present wherein the true cause resides that brings about this abnormal production of cork cells and the consequent loss of surface cells to form the scab. Over twenty-three years ago Dr. Nobbe,* in raising some seedling potatoes by water culture, observed that the tubers growing in the confined air of vessel above the water were normally smooth, while those under the the water were covered with glistening white warts produced by the excessive growth of lenticels, and he suggested that this "might possibly contribute to the explanation of the formation of scab in the field."

Lenticels are normal structures which serve for the ready exchange of gases (oxygen, carbonic dioxide, etc.), between the inside and outside of stems living for more than one year. In the potato tuber (which is an underground stem) the lenticels are scattered without order over the surface and are less than a pinhead in diameter. They are not conspicuous in the stored tubers, but in young or freshly dug tubers they are usually easily seen, especially if permitted to swell up by being placed in water for a day or more. Lenticels have a corky texture, but the cells are rounded and permit the passage of air between them. Figure 2 shows a vertical section from the skin of a young potato (one inch in diameter), passing through a lenticel. Before making the section the skin was entirely separated from the other tissues of the tuber by masceration, thus exhibiting more clearly the exact thickness of the skin and the nature of the break in continuity made by the lenticel.

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*Landwirthsch. Versuchs-Stationen, VI, 1864, p. 60.

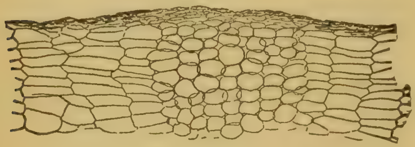

FIGURE 2.

Transverse section of the skin of a young potato, cutting through a lenticel. Magnified 85 diameters. Original.

Ten years before Dr. Nobbe made the remark quoted above, a careful account of the scab — its appearance, microscopic structure and origin, together with the conditions favoring its growth — was given with fine illustrations in a report on investigations undertaken for the Prussian government by Dr. Schacht.* He pointed out that the conditions favoring the excessive growth of the lenticels also help to carry this growth over into the form of scab, and that marl, bog iron and street sweepings applied to the soil are supposed to have something to do with the increase of the trouble, and adds: "I must consider great moisture of the soil as the first cause." Little substantial addition has been made to our knowledge of the subject since the time of Schacht.† The latest and most complete account is by Sorauer‡ in his new handbook of plant diseases.

The experiments undertaken by the Station this season to test some points in connection with the question of scab have been in charge of Mr. M. H. Beckwith, the assistant horticulturist, and a full account of them will be found in his report in this volume. There were four points aimed at, as follows: To test the influence upon the crop (1) of the use of scabbed potatoes for planting, (2) of the application of fungicides and special fertilizers, (3) of the degree of moisture in the soil, and (4) of the use of stable manure. Upon the first and second points the results are not specially convincing, but there seems to be no room for doubt that as regards the amount of moisture in the soil and the presence of stable manure both materially increase the quantity of scab. It is probable that stable manure acts chiefly by raising the percentage of moisture retained by the soil. Altogether, the result of the experiments seems to bear out the hypothesis of Schacht that the chief cause of potato scab is the deleterious action of soil moisture on the skin of the tuber; the incidental circumstances which favor the action cannot be discussed at this time.

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* Bericht über die Kartoffelpflanze und deren Krankheiten, 1854, p. 24.

† His report furnishes the basis of what is given in the Rep. Conn. Agric. Exper. Station, 1877, p. 67, and 1886, p. 79.

‡ Pflanzenkrankheiten, 2te Aufl., 1886, p. 227.

PLUM-LEAF FUNGUS.

A very full account of this fungus, its appearance, transformations, development and influence upon the health of the plum and allied trees, was given in the last report of this Station,* and it is only necessary at present to supplement that account by some additional items the result of later studies, especially in regard to the form and occurrence of the perfect spores, and the value of topical applications for checking the spread of the fungus.

It has already been stated that the fungus continues its growth after the leaves fall to the ground, the abundant production of spores on the green leaves being replaced, as winter comes on, by spores of a different sort on the now dead leaves, and the whole aspect of the fungus becoming changed; with the advent of spring another change takes place, and the life cycle is completed by the production of ascospores, the presence of which in any fungus is taken to indicate the highest development that the species attains.

The course of development of the spores has been studied with a great abundance of material, provided through the kindness of Mr. William Smith, of Geneva, who permitted some ground, well covered with fallen plum leaves bearing the fungus, to lie uncultivated until after my studies were completed. As noted in previous years, the asci, or spore sacs, can be seen by the first of May, but without well-defined spores.

The ascospores were found toward the latter part of May, and were well developed by June 1st. These spores are linear, somewhat curved (not oblong, as stated in last year's report, p. 296), nearly the length of the sac, in which they are closely packed, and from which owing to their colorless and delicate walls they are with difficulty distinguished when the sac is unruptured. Figure 3 shows a sac filled

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* Report for 1886, p. 293.

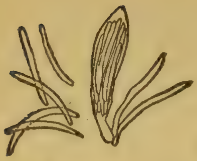

FIGURE 3.

An ascus filled with spores, with two paraphyses attached to it, and five free spores. Magnified 290 diameters. Original.

with spores, and beside it two of the sterile filaments usually associated with such sacs, but of no interest in this connection, together with some free spores. The sacs and their accompanying filaments are ranged side by side in a uniform layer, which is for a while entirely surrounded by a black covering that the fungus forms in the remains of the dead leaf. When the spores are ripe the covering breaks away above the layer, and they are free to escape; this layer is always of the same depth, but of variable breadth. Figure 4 shows a vertical section through a leaf containing two small fruiting cavities. The covering has already opened over the center of each. At this state of development the spores are ready to be ejected, and to be deposited by the wind on the surface of the green leaves of plum trees in the vicinity, to start anew the septoria condition, leading to the early destruction of the foliage.

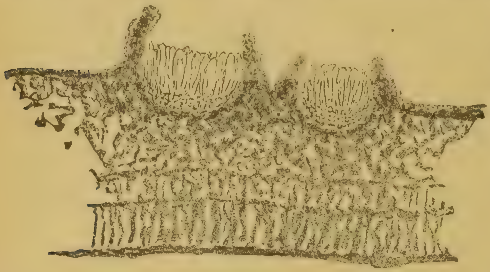

FIGURE 4.

Vertical section of two perithecia, showing mature asci. Taken from a leaf gathered June 18. Magnified 110 diameters. Original.

The report of last year advises to "spray the foliage during May and June, or even longer, with some fungicide," and hyposulphite of soda or sulphide of potassium are recommended for trial. This suggestion was put to the test by using the latter substance, applying it in a solution of one-half ounce to the gallon of water, from May 25 to June 27. (The details of this experiment are given at another place in this report.) Very encouraging results followed, but it was evident, that for this season at least — the earlier part being unusually dry — the spraying need not have been started so early, and should have been continued longer. Septoria spots were not found on the leaves till about the middle of June, and the spraying need not have begun much earlier than this. Further trials will be needed to settle the details of the method to insure uniformly good results.

SULPHIDE OF POTASSIUM AS A FUNGICIDE.

Sulphur has been the general remedial agent with gardeners, horticulturists and agriculturists for all disorders of plants, either due, or supposed to be due to the incursions of fungi, from a time much beyond the memory of the present generation of investigators. Flowers of sulphur is the form most convenient of application, and the one in common use. More thorough and accurate observations in recent years, together with a better knowledge of the plant maladies which it is intended to disperse or prevent, have demonstrated that the useful application of sulphur is more limited than previously supposed.

For additional remedies, attention has naturally been turned to the compounds of sulphur, and especially to the sulphates, sulphate of iron and sulphate of copper being found of service in combating a number of forms of plant diseases.

Some two or three years ago the sulphides began to receive attention in Europe, particularly the sulphide of potassium, which was found a valuable exterminator of the surface or powdery mildews. The same agent was tried to some extent in this country last year (1886), a few brief accounts being given in the agricultural and gardening journals.

At the opening of the present season (1887), it was planned to give this substance a thorough trial upon several diverse forms of plant diseases, not only on those which grow upon the surface of the host and are therefore easily reached by topical application, but on the endophytic forms which grow, with the exception of their spore-forming parts, inside the host.

Gooseberry Mildew. — On June 4 a solution of the strength of one-half ounce of the sulphide of potassium to a gallon of water was sprayed over two plants of considerable size of the Industry gooseberry, an English variety, the ends of the branches and a part of the fruit being quite completely enveloped with the common gooseberry mildew (Sphærotheca Mors-uvæ B. and C.) In places the mildew had passed the first or conidial stage, when it is glistening white with powdery spores, and had reached the second stage, forming a brown felted layer on which are produced minute black fruit-dots containing the winter spores. The mildew had already affected the growth of the plants, having caused the new growth of stems to become more than normally thickened, and also stunted the development of the new leaves. Some seedling gooseberries of two years' growth, almost as much diseased, were also sprayed with the solution at the same time.

The spraying was repeated on June 9, 20 and 27, each of these dates being subsequent to a shower which presumably washed off the sulphide from the bushes.

The beneficial effects were noticeable from the first; most of the fungus in its early white stage was killed, and the production of summer spores fully checked for the time being. The part of the fungus which had become brown, however, was proof against the application, having no appearance of being affected in the slightest degree. Obviously it was impossible on this account to rid the plants of the parasite, and while the fungicide did much to mitigate the evil, it did not eradicate it.

Enough was accomplished, however, to show that, if taken in time, gooseberries may be kept entirely free of mildew by a proper application of sulphide of potassium in solution, and without the slightest detriment to the foliage or fruit.

Pear Scab. — The good results which have appeared to follow the use of hyposulphite of soda for pear and apple scab in the hands of Mr. Goff, as detailed in former reports of this Station, suggested the use of sulphide of potassium in the same way, as probably having stronger fungicidal properties and less likely to injure the foliage.

The solution of the strength of one-half ounce of the sulphide to a gallon of water was sprayed upon half the top of a vigorous fruiting tree of each of three varieties of pear — Flemish Beauty, Seckel and Mt. Vernon. Both fruit and leaves of the first and second of these have in former years been badly disfigured and injured by the scab or rust (Fusicladium pyrinum).* Applications were made on May 25, June 1, 4, 20 and 27. The fungus did not, however, appear on either the unsprayed or the sprayed parts in harmful quantity, probably because of the comparatively dry weather; and the fruit having passed the period of growth most susceptible to attack of the fungus, the experiment was given over, without having reached any result more important than that the application does not injure or in any way affect the green or other parts of the tree.

Diseases of Plum Leaves.— The premature falling of the leaves of plum trees, as described on another page of this report, is a sufficiently serious malady in this locality, and doubtless elsewhere, to make a remedy, if only a partial one, desirable.

Two rows thirty feet long of three-year-old trees in the midst of nursery stock, kindly placed at my disposal by the owner, Mr. William Smith, were sprayed at the same time and in the same manner as the pear trees mentioned above.

But faint results were observable at the time of the last spraying the last of June, the fungus not having appeared in sufficient quantity to be conspicuous, but in July and even as late as the last of August, the difference between the sprayed and unsprayed trees was strongly marked by the less spotted and clearer green foliage and its greater persistence. It seems probable that much better results would have been attained if the main part of the spraying had been done during July and extending into August.

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* For a description of the fungus and its effect see Third Annual Rep. N. Y. Agric. Exp. Station, 1884, p. 367.

The theory of the action of the fungicide is that the spores are prevented by its presence from germinating upon the surface of the foliage, and the fungus thus kept from entering the leaf, and that both the fungus threads and spores are killed by contact with it. The injury, resulting from the growth of a single spore rarely exceeds a spot one-eighth of an inch in diameter. The effect of one or a few spores upon each leaf is therefore insignificant; it is the great numbers that do mischief. While it is doubtless impossible to entirely prevent the growth of the fungus in the leaves, yet the feasibility of arresting the considerable increase of the spots by suitable topical applications seems reasonable. Whether sulphide of potassium will prove to be such a preventive must be the work of several years to ascertain, but the present season's test looks favorable.

Strawberry Leaf Spot.—A part of a bed of Sharpless strawberries was sprayed four times during June with the strength of solution already mentioned, with the object of holding in check the spotting of the leaves due to the fungus, Ramularia Tulasnei, often described as "sunburn." The object sought was attained, as that part of the bed took on a more vigorous growth and showed fewer spotted leaves than the remainder. In fact the difference between the sprayed and unsprayed portions was so marked that it seems unsafe to ascribe it wholly to the fungicide, it being better to content one's self with the strong indication that the sulphide is likely to prove a serviceable preventive of this disease, and to leave the question of its full efficiency to be determined by future trials.

Other Diseases.—Application of the fungicide was also made at the same time and in the same manner as already mentioned to currant bushes and quince trees. No results were obtained with the currants, where it was hoped to check the common spotting of the leaves caused by the growth of a fungus. The results with the quince trees were equally indifferent. The object in view was to see the effect of the fungicide upon the mildew (Podosphæra tridactyla) and the leaf spotting (Morthiera Mespili, var.), but neither fungus appeared in sufficient abundance to permit of definite observations. After the spraying was begun, and before it was ended, another disease took possession of the trees — the twig blight, due to the same cause as pear blight — and from six inches to a foot or more of the ends of many of the branches died. There was no appreciable difference between the sprayed and unsprayed parts of the tree regarding the amount of blight. The test in this case seems to be entirely satisfactory, and, taken in connection with the failure of hyposulphite of soda last year (Report for 1886, p. 178), is strong evidence in favor of the opinion that the usual manner of applying soluble fungicides and insecticides by spraying is not likely to prove of any service against pear blight, twig blight, and the other forms of the same disease.

General Remarks.— Although for part of the tests the season has proved unpropitious, and in no case was the series of applications made in as complete a manner as could be desired, yet the results are encouraging and warrant the belief that sulphide of potassium will yet prove one of the most valuable fungicides for certain plant diseases, especially those caused by epiphytic fungi, that has so far been tested.

Sulphide of potassium is a solid olive-green substance, usually seen in broken cakes, readily soluble in water, with a rather strong, unpleasant smell, somewhat like that of rotten eggs, but not corrosive to the skin or to clothing. It is sometimes called "liver of sulphur." It sells at retail for twenty-five to sixty cents a pound, according to quantity and place of purchase.

The strength of solution of one-half ounce to a gallon of water is probably the maximum ever required; and it may be found upon further trial that one-half that strength will answer the purpose equally well. Not the slightest injury resulted to the foliage of any of the plants sprayed with it, and if anything were to be gained a stronger solution could just as well be used. As it is not a poisonous substance, unless swallowed in very large doses, no harm will result in spraying fruit which is shortly to be gathered for eating.

The spraying was performed with a Nixon nozzle and force pump, which throws a fine spray with much force to a considerable height, and is rapidly operated. By shifting the direction of the spray, all parts of the foliage are speedily wet with the solution. What falls upon the ground is not lost to the cultivator, for it is a substance that possesses high manurial value as a potash salt. In fact the whole of the substance used for spraying, when finally washed into the ground, becomes available food for the vegetation which it has already served to protect more or less efficiently from fungous ravages.

FRAGMENTARY NOTES.

Scab and Rust of Apples and Pears.— The rust or scab, which usually shows itself in early spring and continues through the season on leaves and fruits, did not become noticeable this year till July. This tardiness in starting may be reasonably ascribed to the dryness of the first half of the year, which prevented the spores from finding sufficient moisture to germinate readily on the surface of the green parts and become established.

Disease of the Clover-leaf Weevil.— Only one larva of this insect was found in the spring of 1887. The fungous disease of the larvæ, described in the two preceding reports, appears to have nearly exterminated the insect from this locality.

Peach Curl.— The early part of the season of 1887 was unusually dry. Whether this prevented the development of the curl or not is uncertain, but for some reason it was almost entirely absent this year. Usually the peach trees of the Station have lost considerable of their foliage by June 1st on account of it, and suffered much in consequence. If it arises each season chiefly from mycelium remaining in the tree over winter, as is certainly the case to some extent, it is difficult to understand why the dry weather should have interfered so much with its development. On the other hand, if it starts each season chiefly from the germination of spores carried to the surface of the tree by the air, it is easy to see that a dry atmosphere would give little chance for the requisite moisture to enable the spores to start into growth, and thus the trees would be saved from the disease. The latter view is strengthened by the observation made two years ago that when all limbs showing any trace of the disease were kept cut away during the whole of the growing season, the tree showed no sensible decrease in the amount of curl the next year.

Gooseberry Mildew.— Foreign varieties of the gooseberry when grown in this country are so generally attacked and injured by mildew that their cultivation is not commonly attempted, and then rarely with success, although the fruit is much larger and finer than that of the native varieties. The particular mildew which in Europe is called the gooseberry mildew, or "blight" as the English usually speak of it *(Microsphœra Grossulariœ* Lév.*)*, is not the one which interferes with cultivation in this country. Our gooseberry mildew is a species of Sphærotheca. It has been referred to as Sphærotheca pannosa Lév. by Bessey * and others, a species which infests the leaves and stems of roses and peach trees in both Europe and America, but, as pointed out by Burrill,† it is doubtless a distinct species that was first described by Schweinitz ‡ under the name of Erysiphe Mors-uvæ, and is now known as Sphærotheca Mors-uvæ B. & C. It appears to be indigenous to North America. Its depredations in the garden, however, are chiefly confined to varieties of transatlantic origin. On these it checks the growth and when abundant dwarfs the whole plant, while the fruit is disfigured and rendered worthless. The ends of the branches are the principal seat of the fungus; these become thickened and succulent, the leaves on them remain small, are close set, and drop prematurely. The fungal threads overspread the surface of the host without penetrating into its interior. They are at first pure white, and with the white spores produce a glistening effect. As the threads grow to be more abundant, they change color and form a characteristic thick brown felt over the branches and fruit. The felted masses may be scraped from the gooseberry fruit, leaving the surface normally smooth and green. The white spores, produced in the greatest abundance, are for the immediate and speedy extension of the fungus to any suitable spot that they may be blown to. The brown felted masses bear small dark bodies, just large enough to be seen with the unaided eye, in which are also spores. The latter sort (ascospores) germinate the following spring, and are the means of continuing the disease from year to year. A remedy of much promise is spoken of in another part of this report.

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*Erysiphe, p. 3; Bulletins Iowa, Agric. Col., Nov. 1884, p. 141; Arthur in Trans. Iowa Hort. Soc., 1883, p. 315.

† Bulletin Ill. St. Lab., vol. II, p. 399.

‡ N. Amer. Fungi, p. 270

Constancy of Characters in the Wild Dandelion.—The varieties of cultivated dandelion show a considerable range of variation in the characters of the leaves, extending from the finely cut or mossy forms to the broad, even forms, and these varieties are quite constant when propagated by seed. It was suggested by the Director of the Station that counterparts of these varieties might possibly be found among wild forms, and that they might show a like constancy of characters when introduced to cultivation. The subject has an important bearing upon the origin of garden varieties, and the possibilities in the way of originating new varieties. It was decided to select as diverse forms of wild plants as possible and transfer to the garden. This was done in spring, when the leaves show the greatest variation. There were four classes — those with finely cut, light green leaves; those with finely cut, dark green leaves, spotted and edged with brown; those with least uneven, light green leaves, and those with least uneven, dark green leaves. In the rich soil of the garden they grew finely, and by September first were large plants. At this date there was still a considerable difference between the light and dark green forms, but the shapes of the leaves exhibited less difference, all having approximated to a much cut and irregular pattern. Although the leaves had grown large, they retained their habit of reclining, instead of standing upright as the garden varieties do. None of the plants have approached, either in shape of leaf or in habit, the cultivated varieties, the chief change that has taken place, aside from size, being in the greater or less dissection of the leaves. The result of one year's observation upon such a question has little value further than to direct additional attention to an important subject. The trial should be carried through several seasons with observations upon the same individuals, and supplemented by ascertaining the constancy of the characters in plants raised from seed through several generations.

Constant Temperature Apparatus.— Considerable time has been given to perfecting an apparatus for keeping a constant high temperature in a space large enough to permit of the introduction of one or two germinating pans for testing seeds. The question to be decided by the apparatus was the highest point at which different seeds will germinate, taking the element of time into consideration. This required some means of keeping a temperature that would not vary more than one degree, or less if possible, for a week or two at a time, or even longer. The chamber had to be heated with a kerosene flame, as gas was not available, and so none of the usual forms of heat regulators could be used. The machine as finally arranged, and which reached a fair state of efficiency, consisted of a chamber, something more than two feet cube, surrounded by dead air spaces, with a copper reservoir of water in the bottom, so connected by pipes with a jacket about the flame of a kerosene lamp as to secure a flow of water. Cold air for lowering the temperature of the chamber when too hot was taken from the bottom of an ice chest placed higher than the chamber in order to secure a flow of air. Valves were placed in the cold air conduit, in the top of the chamber, for escape of hot air when cold air was admitted at the bottom, and in the top of the ice chest, to allow as much air to pass in as was drawn off to supply the chamber. These three valves were automatically opened and the lamp turned down when the temperature of the air in the chamber reached the highest permissible point, and were closed and the lamp turned up again when it dropped to the lowest point — the variation being a degree or less. The power for making these changes was secured by means of a clock work having a heavy spring, reinforced to any extent with a weight and system of pulleys. The clock was set in motion by an electro-magnetic connection with a vibrating thermostat placed in the chamber, regulated to the desired degree of temperature. It was found that, although no fault could be detected in the apparatus, there was still an uncontrollable although slight variation of temperature disturbing the nicety of the results, doubtless to be ascribed to the great changes of temperature in the room in which the apparatus stood. It is believed that if it were placed in a room having at the most only five to ten degrees of fluctuation, there would be no further hindrance in securing absolutely satisfactory results.

WEED STATISTICS.

The problem of the weeds is one that every cultivator finds sufficiently perplexing at all times. It is a question that must have an answer of some sort, and the answer that can stand the test of practical application, giving upon trial the least loss and the greatest gain, is the best one. The statistics which are given in this connection are presented with the hope of adding a little to the knowledge of the subject, and to the elucidation of the problem.

The number of weeds of different kinds growing upon one-twentieth of an acre was determined by the same methods used last year and the year before.* This year, as in the preceding years (although not so stated in former reports), the land was plowed and harrowed in May, and then left undisturbed for the remainder of the season, except the small disturbance of the surface in pulling up the weeds at the time of counting. The plowing did not take place until after many seeds had begun to grow. This probably does not materially affect the results, as the seeds which finally grew are those turned up by the plow, while those that were at or near the surface were mostly buried too deep to grow during the current season.

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* Report for 1885, p. 262; 1886, p. 298.

Weeds Growing on One-Twentieth of an Acre.

COMMON NAME.	LATIN NAME.	A.	B.		C.
		1885.	1886.	1887.	1887.
Three-seeded Mercury	Acalypha Virginica L.	2	18	12	41
Couch-grass	Agropyrum repens B.	......	46	590	......
Pigweed	Amarantus albus L.	......	2	6	39
Redroot	Amarantus retroflexus L.	4	134	380	1,395
Ragweed	Ambrosia artemisiæfolia L.	62	48	20	3,022
Burdock	Arctium Lappa L.	1	......	......	11
Milkweed	Asclepias Cornuti Dec.	67	......	......	43
Shepherd's Purse	Capsella Bursa-pastoris M.	2	18	5	55
Mouse-ear Chickweed	Cerastium vulgatum L.	......	3	......	5
Pigweed	Chenopodium album L	21	400	244	1,866
Ox-eye Daisy	Chrysanthemum Leucanthemum L.	3	......	......	8
Canada Thistle	Cnicus arvensis Hoffm	4,380	8	930	105
Spurge	Euphorbia maculata L	69	3	62	822
Catnip	Nepeta Cataria L.	2	......	......	2
Wood Sorrel	Oxalis corniculata L., var.	62	1	2	4
Witch Grass	Panicum capillare L.	123	12	11	57
Barn-yard Grass	Panicum Crus-galli L.	11	10	150	317
Low Finger-grass	Panicum glabrum Gaud.	516	4	34	11,790
Timothy	Phleum pratense L.	27	......	......	1
Ground Cherry	Physalis Virginiana Mill.	......	1	1	......
English Plantain	Plantago lanceolata L.	162	1	......	356
Common Plantain	Plantago major L.	10	4	......	41
Common Plantain	Plantago Rugelii Dec.	1	21	......	201
Fowl Meadow-grass	Poa serotina Ehr.	......	4	7	3
Knotgrass	Polygonum aviculare L.	7	21	12	71

Weeds Growing on One-Twentieth of an Acre.—(Continued.)

COMMON NAME.	LATIN NAME.	A.	B.		C.
		1885.	1886.	1887.	1887.
Black Bindweed	Polygonum Convolvulus L	12	81	52	6
Lady's Thumb	Polygonum Persicaria L	120	831	684	468
Purslane	Portulaca oleracea L	......	6	176	10,335
Smooth Sumac	Rhus glabra L	1	1	......	1
Sheep Sorrel	Rumex Acetosella L	20	......	......	2,490
Curled Dock	Rumex crispus L	3	......	......	3
Groundsel	Senecio vulgaris L	......	2	6	60
Fox-tail Grass	Setaria glauca Beauv	2,233	133	1,843	2,643
Pigeon Grass	Setaria viridis Beauv	420	1,810	6,787	816
Sow Thistle	Sonchus asper Vill	......	3	24	......
Sow Thistle	Sonchus oleraceus L	1	......	2	2
Sorghum	Sorghum vulgare L	......	173	2	......
Dandelion	Taraxacum officinale L	129	6	......	28
Red Clover	Trifolium pratense L	4	122	2	1,205
Yellow Clover	Trifolium procumbens L	1	......	1	117
White Clover	Trifolium repens L	37	122	23	35
All other kinds	......	296	46	......	18

Two plats were selected this year on which to determine the number of weeds, one being the same as used last year, and the other a piece of ground just turned over from an old meadow. The latter lay adjoining a roadway, and was found to be very full of foul seed. Neither piece of ground has received stable manure for a number of years, if at all. The countings were made about the first of July, August and September, the larger weeds being pulled and removed from the ground each time, leaving the smaller ones to grow until the next counting, the ground being cleared at the last date.

The three plats of ground used for these experiments lie near one another, having practically the same kind of soil and exposure, and differing chiefly in the length of time since they were in meadow. The plat used in 1885 is marked A in the table, that used in both 1886 and 1887 is marked B (C 11 in the records of the Station), and the second plat used in 1887 is marked C (G 2 in the records of the Station).

The table includes by name those species that occurred in 1887, and also in one or both of the preceding years. Those which occurred in 1885, but not in the other years, are as follows, with the number of individuals of each: Anemone Virginiana 1, Ambrosia trifida 68, Aster Novæ-Angliæ 3, Hypericum mutilum 1, Lactuca Canadensis 1, Pastinaca sativa 3, Poa pratensis 194, Polygonum acre 14, Polygonum Pennsylvanicum 2, Rubus strigosus 5, and Solidago Canadensis 4.

Most of these species are adventive from the meadow, which in this case had only been turned under at the last plowing; they would not withstand much tillage. The largest number of individuals is of Kentucky blue grass. The kinds which occurred in 1886 and not in other years, with the amount of each, are as follows: Helianthus annuus 40, Lycopersicum esculentum 1, Stellaria media 1, Verbascum Thapsus 3, and Veronica peregrina 1. These species belong to cultivated ground, being in part, not weeds proper, but accidental sowings of cultivated plants, which had occupied the ground or the vicinity the previous years. No species was recorded in both 1885 and 1886 that was not found in 1887. The following are the species found in 1887 not found in previous years: Daucus Carota 8, Erigeron Canadense 2, Lobelia inflata 2, Malva rotundifolia 4, Sisymbrium officinale 1, and Silene noctiflora 1, all common weeds of roadsides and fields.

Of the thirty-three kinds of weeds mentioned in the table the following are especially pernicious and troublesome to field crops:

Weeds Especially Troublesome to Field Crops.

Red Root	Amarantus retroflexus L.
Ragweed	Ambrosia artemisiaefolia L.
Pigweed	Chenopodium album L.
Barn-yard grass	Panicum Crus-galli L.
Low Finger-grass	Panicum glabrum Gaud.
Lady's Thumb	Polygonum persicaria L.
Purslane	Portulaca oleracea L.
Foxtail grass	Setaria glauca B.
Pigeon grass	Setaria viridis B.

Could these nine kinds be banished from the country the warfare with weeds would be reduced one-half. Curiously enough, all of these but the ragweed are of foreign nativity, having emigrated to this country, and taken a more vigorous hold of the soil than the native plants. A few additional kinds are very obnoxious now and then because, while they do not spring up everywhere like those mentioned, yet when once established they are with much difficulty eradicated; such are Canada thistles, quack grass, milkweed, sorrel, burdock, and ox-eye daisy. Other kinds, like shepherd's purse, chickweed, and speedwell, are very common in rich garden soil, but are easily suppressed.

An answer to the query of what weeds and how many of a kind grow upon a definite area of cultivated soil was sought for in a different way. A square foot of surface soil, taken to a depth of three inches, December 11, from a plat (E 1 of the Station records) which had had clean culture, was transferred to the greenhouse. The same was done with soil from a plat (E 4 of the Station records) which had been allowed to run to weeds unchecked the previous season. Each was kept properly watered and remained undisturbed till the first of each succeeding month, when all germinations were counted and recorded, the plantlets removed, the ground thoroughly stirred (with one exception), and the soil again compacted, ready for the next month's growth. Soil was also taken from the same plats, in the same manner, only to one-half the depth, on April 14, and received like after treatment. The results of these trials are given in the accompanying table, in which the monocotyledonous plants, represented by the grasses, and the dicotyledonous plants, including all other sorts, are kept distinct.

Weeds in One Square Foot of Soil.

TIME OF COUNTING.	TAKEN FROM PLAT E, 1.				TAKEN FROM PLAT E, 4.			
	DECEMBER 11.		APRIL 14.		DECEMBER 11.		APRIL 14.	
	Grass.	Other weeds.	Grass.	Other weeds.	Grass.	Other weeds.	Grass.	Other weeds.
January	5	4	....	....	17	18	....	......
February	3	2	....	....	11	66	....	......
March	6	3	....	....	3	82	....	......
April	7	13	....	....	1	35	....	......
May	7	8	79	24	0	71	245	234
June	1	0	1	12	2	11	11	13
July	3	12	0	4	1	38	7	69
August	0	11	1	11	0	14	0	53
September	0	2	0	3	0	9	0	5
October	0	5	0	3	0	5	2	4
November	0	0	0	0	0	0	6	0
December	0	0	0	0	0	0	0	0

It is interesting to note that the soil which was longest exposed to the winter cold gave the largest number of germinations, although there was only half as much of it (exposing the same surface to the air, however). The grasses (mostly *Setaria glauca* and *viridis* apparently) also gave a larger yield, in proportion to the other weeds, in the soil longest out of doors. Increasing these figures to the basis of one-twentieth of an acre, in order to compare with the actual yield of weeds on such an area during one season, it will be found that the number is much greater than has been found by actual count, which indicates, probably, that in the open ground, within two or three inches of the surface, all the weeds do not find favorable conditions for germination during a single season.

The subject was also looked at from another point of view. Attempts have been repeatedly made at the Station to learn something of the germinating qualities of weed seeds—are all the seeds produced so lavishly by each plant really capable of germination? Our inquiries have always been cut short by finding that weed seeds gathered, preserved and tested in the same way that garden seeds are gave from none to seven or eight per cent of germination only, which was manifestly so greatly at variance with the truth, if one is to trust his daily observations, that some fault in the method was suspected.

Germination of Weed Seeds.

COMMON NAME.	LATIN NAME.	PERCENTAGE OF GERMINATIONS OF SEEDS GATHERED AT DIFFERENT DATES.		
		Sept., 1886.	Apr. 2, 1887.	June 8, 1887.
Wild Aster	Aster Novæ-Angliæ L.	3	....	......
Beggar Ticks	Bidens frondosa L.	1	....	......
Heal-all	Brunella vulgaris L.	0	....	......
Shepherd's Purse	Capsella Bursa-pastoris M.	0	....	0
Pigweed	Chenopodium album L.	....	8	......
Wild Carrot	Daucus Carota L.	73	0	......
English Plantain	Plantago lanceolata L.	27	....	......
Common Plantain	Plantago Rugelii Dec.	2	....	......
Dandelion	Taraxacum officinale W.	....	....	92

The accompanying table gives the results of later studies. Seeds were gathered in September, 1886, and kept as garden seeds are till April of the following spring, then tested between folds of moist cloth in the germinating pans commonly used at the Station. Of one hundred seeds each of the wild aster, beggar's ticks, heal-all, shepherd's purse, common plantain, English plantain and wild carrot, only the last two gave more than three per cent of growth, those being twenty-seven and seventy-three per cent respectively. English plantain, also known as rib-grass, and called "buckhorn" by our workmen, is sometimes grown as a forage plant, and the wild carrot is the same species as the cultivated form and but little removed from it. Both might with some propriety be looked upon as escapes from cultivation; at least they have one property which adapts them to the routine of cultivated plants — the seeds can withstand dryness between the usual period of harvest and seed-time, apparently in proportion as their ancestry may be supposed to have been removed from wildness.

Seeds of pigweed and wild carrot were also gathered April second, from stalks that had remained over winter where they grew, and one hundred seeds of each, apparently sound and well developed, were tested in the germinating pans, being put in as soon as gathered. None of the carrot grew and only eight of the pigweed.

On June eighth, seeds of dandelion and shepherd's purse were gathered and at once put into the testing pans; not a seed of the latter germinated, but ninety-two per cent of the dandelion did, and a duplicate trial of dandelion seed in moist sand gave nearly the same percentage. So far as dandelion seeds are concerned it is evident that practically all the seeds which a plant produces are capable of growth.

Weeds seem well able to take care of themselves, but some of them, at least, do not appear to be well fitted for the ways of cultivated plants. If, indeed, it proves to be true upon further inquiry that some weed seeds are made incapable of germination by being kept dry for three or four months or so, it will be a comforting fact to know, as the danger of fouling land with those particular kind of weeds, by seeds conveyed in grain and garden seeds, will be shown to be much less than supposed.

Summary.

The following summary will present the subjects which have been treated in the four annual reports, including the present one, made by the writer, to the New York Agricultural Experiment Station, in a more orderly connection. It also includes references to all other matter upon the same subjects, to be found in the several reports of the Station from the first (1882) up to and including the present one, properly accredited to the respective writers.

The first botanist's report (1884) begins with a short account of the rôle of parasitic and saprophytic fungi in plant diseases, general structure of fungi, and the use of fungicides.

Pear.— The most prominent subject of inquiry has been that of pear blight, or what is least used but the better name, fire blight. The report for 1884 goes over the ground of Professor Burrill's investigations, confirming his observations respecting the presence and activity of bacteria in connection with the disease, its infectious character as shown by inoculation, and the identity of pear blight and twig blight of the apple and quince. It was found that the disease could also be extended to various pomaceous fruits not tested by Professor Burrill, but could not be induced in plants of other orders. Inoculation in the green fruit, taking up an original line of research, was found more certain of results than in the branches, and this with other things led to the belief that succulency has to do with the fullest development of the disease. Reasons are given for thinking that the bacteria accompanying the disease are the cause of it. The probable manner of the propagation of the disease from tree to tree is outlined, and suggestions made as to remedies and preventions. In 1885 a rigid proof is given that the bacteria *(Micrococcus amylovorus* Bur.), which are always found accompanying the disease, are the actual cause of it. The discovery was made that the entrance of the bacteria into the tissues of the trees is effected through the center of the flowers and through the delicate growing tips of branches. An attempt was made to learn why some varieties suffer more from the disease than others, but with indifferent success. The mode by which the disease is normally propagated and spread is more fully stated. Some facts are given about the development of the germs in artificial cultures, and the chemical and other changes which they bring about. In 1886 the proof of the bacterial nature of the disease is reviewed and further strengthened, the forms and transformations of the germs are described and illustrated, and the chemical changes they bring about further treated of, including the proof that they do not form a poison in the branches of the trees Statistics and experiments are produced to further show the relation of blight to succulency and to explain why the disease varies in different varieties of the same kind of fruit. It is further shown that the bacteria may live and propagate in common garden soil. An index of forty-three titles, with a short synopsis of each article, is provided to some of the chief opinions which have been expressed on the subject in various journals and reports, covering the time from 1794 to 1886.

The other diseases of the pear which have been treated of are the leaf blight, scab or rust, as it is severally called, due to the fungus Fusicladium pyrinum, with suggestions for its treatment, the blackening or browning of the leaves due to Morthiera Mespili, and the yellowing of the leaves due to want of sufficient nutrition, all in the report for 1884, with a note on scab, in the present report. There is also a note on the use of hyposulphite of soda as a preventive of scab by Mr. E. S. Goff in the 1886 report.

Apple.—The diseases of the apple that have been taken up are a brief account in the 1884 report of twig blight, already referred to above, and leaf blight or scab, due to Fusicladium dendriticum, and a note on the latter in the present report. Experiments in the use of hyposulphite of soda as a preventive of apple scab are given by Mr Goff in the reports for 1885, 1886 and the present year.

Quince.—Twig blight in quince, due to the same cause as pear blight, mildewed leaves caused by Podosphæra tridactyla, rotting of the fruit by Sphæropsis Cydoniæ, and spotting of the leaves by a variety of Morthiera Mespili, are all briefly treated in the report for 1884, no remedies being offered, and the last disease when attacking the fruit is described and illustrated in the report for 1885.

Peach.—A few remarks on peach yellows, and quite full accounts of curl and gumming or gummosis are given in the 1884 report. The opinions and researches of foreign investigators are cited and supplemented by experiments carried on at the Station. An additional item on the curl is given in the present report.

Plums and Cherries.—A full account and careful investigations on the common rotting of the fruit, found to be due to Oidium fructigenum, are to be found in the 1885 report, with illustrations. In the 1886 report is an equally full account, based entirely upon new researches, of the cause of the premature dropping of the leaves. It is found to be due to the fungus known under the name of Septoria cerasina, the life history of which is traced out, excepting part of the details of one stage, which are supplied in the present report. The different parts of the fungus and the appearance of infected leaves are illustrated with cuts. Preventive and remedial treatment for the disease is suggested.

Potato.— The present report contains a description of the scab of potatoes, the structure in health and disease of the skin of the tuber, and an account of researches toward ascertaining the conditions favoring the disease and possible prevention, partly by Mr. M. H. Beckwith and partly by the writer. There is a suggestion regarding the active agent in potato rot at page 257 of the report for 1885, and statistics are given by Mr. E. S. Goff in the same report regarding the percentage of decay of tubers belonging to different varieties grown upon the Station grounds.

Tomato.— The rotting of ripe and green fruit is described and some of the fungi associated with the same are illustrated in the 1884 report. The subject is continued in the two succeeding reports, but no final conclusions are reached. Additional facts and observations are recorded by Mr. E. S. Goff in each report from 1882 to 1887 inclusive.

Lettuce.— In the 1885 report the mildewing or rotting of lettuce, due to Peronospora gangliformis, is described and illustrated; and in the same report a history and description of the rusting of the leaves by the fungus Septoria Lactucæ is given with illustrations.

Gooseberry.— The present report gives some account of the mildew of the gooseberry and a remedy for it.

Strawberry.— An account of the comparatively rare trouble with strawberries in this country, due to the mildew, Sphærotheca Castagnei, is found in the report for 1886.

Cucumber.— The harmful spotting of the green fruit by a Cladosporium is recorded by Mr. M. H. Beckwith in the present report, with a note by the writer.

Clematis.— The rotting away of the roots of clematis, causing a serious loss in the propagating house and among plants grown out of doors, was carefully investigated (1884) and found to be due to a fungus, the name of which was not determined.

Oats.— Exact statistics are given in the 1884 report showing the percentage of smut in oats as usually grown, and demonstrating that there is much more loss from it than commonly supposed. Further statistics of the same nature are given by Mr. C. S. Plumb in the report for 1886, together with the results of treating the seed in various ways for the prevention of smutting, with valuable practical conclusions.

Weeds.— The number of weeds and the kinds growing upon one-twentieth of an acre of undisturbed soil in a cultivated field were carefully counted in 1885, 1886 and 1887. The number of seeds found to germinate in several samples of surface of soil taken from a cultivated field in winter and placed in the greenhouse are recorded in the present report. The amount of soil taken was a square foot to the depth of one and a half to three inches. The present year's report also contains the record of the germination of several kinds of weed seeds which received different preliminary care. These various statistics give occasion for some inferences of a practical character. The report for 1884 also has some account of several of the fungous parasites which infest weeds, and to some extent help to keep them in check.

Clover-leaf Weevil.— This insect, which has proved destructive to the clover crop in some places, was found to have its larvæ infested with a disease caused by a fungus new to science, Entomophthora Phytonomi. The fungus is fully described and illustrated in the report for 1885, except one form of spore germination, which is given in 1886. The effect of the disease upon the insect, its means of propagation and distribution are stated. A note in the present report shows that the fungus is an efficient check to the insect's multiplication.

Fungicides.— Beside the account of trials with sulphide of potassium in checking and preventing fungous diseases of plants, given in the present report, there are short notes about trials of other substances, and suggestions regarding still others, scattered through the several reports, for which the index is to be consulted. Mr. E. S. Goff has recorded the results obtained by use of hyposulphite of soda as a fungicide in the reports for this and the two preceding years.

Other Topics.— The present report also contains notes on the constancy of leaf characters in the dandelion when brought under cultivation, and on a form of apparatus for keeping a constant high temperature, together with further notes relating to all the reports of the Botanist, and an index to them.

PUBLICATION OF THE REPORTS FOR 1884–1887.

The report of the Station for 1884 (third), was published by the State from the press of Weed, Parsons & Co., Albany, N. Y., and distributed in September, 1885. Excerpts of the botanist's part with special cover, but without change of paging, were distributed a week or two earlier in the same month. The report of 1885 (fourth) was published by the Station from the press of E. R. Andrews, Rochester, N. Y., and distributed in March, 1886. Excerpts with special cover and without change of paging were distributed January 30, 1886. The report was also published by the State from the press of Weed Parsons & Co., Albany, N. Y., and distributed in November, 1886. Excerpts from the latter are called the "second edition" on the special cover, and were distributed in December, 1886. They are separately paged, but have a table showing the corresponding paging in both the State and Station editions. The report for 1886 (fifth) was published by the Station from the press of the Advertiser Association, Elmira, N. Y., and distributed in February, 1887. Excerpts with special cover and without change of paging were distributed January 30, 1887. This excerpt has an unfortunate typographical error on the cover, making the year of the report read "1887," instead of 1886. The 1886 report was printed for the State by the Argus Company, Albany, N. Y., and distributed October, 1887. The excerpts from the State or "second" edition, with special cover and without change of paging, were distributed October 15, 1887. This excerpt includes part of Mr. C. S. Plumb's report of "smut in oats," and Mr. E. S. Goff's report on "hyposulphite of soda as a fungicide," and also has a prefatory note.

Index to Botanist's Reports for 1884, 1885, 1886 and 1887.

The Roman numerals refer to the volume, the Arabic to the page. The volumes I to IV correspond to the years 1882 to 1887. From 1882 to 1884 inclusive, only one edition of the reports was published. The reference to reports issued since 1884, are to the editions published by the Station. The page for the State edition of 1885 can be ascertained by adding 27 to the given page of the Station edition of that year. References to the writings of Mr. C. S. Plumb, Mr. E. S. Goff and Mr. M. H. Beckwith, relating to plant diseases, are inclosed in brackets.

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REPORT OF THE CHEMIST.*

This report deals chiefly with the composition and general properties of butter, especially as affected by breed or individuality of cow, and to some extent by food; a discussion of lysimeter results, and a record of sunshine for the year.

EXAMINATION OF BUTTERS FROM THE NEW YORK DAIRY SHOW.

The sweepstake prizes offered at the New York Dairy and Cattle Show, held at Madison Square Garden in May last, for the cow producing the greatest quantity of milk during twenty-four consecutive hours of the exhibition, and the cow producing the greatest quantity of butter during the same time, were competed for by representatives of the Holstein, Jersey and Guernsey breeds. The cows competing for these prizes were thirteen in number, there being seven Holsteins, five Jerseys and one Guernsey. The following list gives the name, owner and breed of cow together with the yield of each.

The cows Nos. 5, 7 and 8 competed for the milk prize only. Nos. 3, 6, 9, 10, 11, 12 and 13 for the butter prize only; the others competed for both milk and butter prizes:

---

*S. M. Babcock.

No,	NAME OF COW.	Owner.	Breed.	Weight of milk.	Weight of butter.
1	Clothilde, 1308 H. H. B., 8 years old	Smiths, Powell & Lamb	Holstein	63 lbs. 1½ ozs.	2 lbs. 7½ ozs.
2	Lady Fay, 4470 H. H. B., 8 years old	Smiths, Powell & Lamb	Holstein	65 “ 13½ “	1 “ 10¼ “
3	Clothilde 4th, 3480 H. H. B., 4 years old	Smiths, Powell & Lamb	Holstein	58 “ 10 “	2 “ ¼ “
4	Mechtchilde, 6718 H. H. B., 4 years old	F. C. Stevens	Holstein	64 “ 15 “	1 “ 14 “
5	Jewel, 668 H. H. B., 9 years old	F. C. Stevens	Holstein	59 “ 15½ “	.. “ .. “
6	Movike 3d, 1540 H. H. B., 7 years old	James Nielson	Holstein	27 “ 3 “	1 “ 2¾ “
7	Ekster 2d, 1543 H. H. B., 6 years old	James Nielson	Holstein	45 “ 9½ “	.. “ .. “
8	Shonemunk Maid, 12578 A. J. C. C., 6½ years old	Oscar Ricklefsen	Jersey	26 “ 9½ “	.. “ .. “
9	Water Lily, 11797 A. J. C. C., 6 years old	Oscar Ricklefsen	Jersey	23 “ 2 “	.. “ 14½ “
10	Island Chrissie, 12007 A. J. C. C., 8 years old	Green Mountain Stock Farm	Jersey	27 “ 11 “	1 “ 8¾ “
11	Gold Lace, 10726 A. J. C. C., 11 years old	Green Mountain Stock Farm	Jersey	33 “ 13 “	1 “ 14½ “
12	Hilda A. 3d, 16636 A. J. C. C., 6 years old	F. Bronson	Jersey	31 “ ½ “	1 “ 9¾ “
13	Jessie of Lester Manor, 740, 9 years old	Francis Shaw	Guernsey	40 “ 3 “	1 “ 14½ “

The milk prize was awarded to Lady Fay, she having given 65 lbs. 13½ oz. of milk, and the butter prize to Clothilde, with a yield of 2 lbs. 7½ oz. of butter. The average amount of milk given by the six cows competing for the milk prize was 54 lbs. 5½ oz. The average for the five Holsteins was 59 lbs. 14 oz.

The average yield of butter for the ten cows competing for the butter prize was 1 lb. 11¾ oz. The average for the five Holsteins was 1 lb. 13.6 oz., and for the four Jerseys 1 lb. 7.9 oz. The yield of the single Guernsey entered was 1 lb. 14½ oz.

The pounds of milk required for one pound of butter in each case were,

Holstein.		*Jersey.*	
Clothilde	25.55	Water Lily	25.52
Lady Fay	40.13	Island Chrissie	17.90
Mechtchilde	34.63	Gold Lace	17.73
Clothilde 4th	29.08	Hilda A. 3rd	19.28
Movike	23.20		
Average	30.52		20.11

Guernsey.

Jessie of Lester Manor, 21.01.

Average for all, 25.4 lbs. milk for one pound of butter.

Considering that these cows were in a strange place and for most of the time during the test were surrounded by a crowd of strangers, the yields are remarkable.

We were prepared, and earnestly desired to analyze both the milk and butter of the cows competing for these prizes, but it was not possible to obtain samples of the milk, and this most essential part of a test of this kind was necessarily abandoned. Analyses of the test butters from each of the cows competing are given below:

	NAME OF COW.	Yield of butter.		ANALYSIS OF BUTTER.			Fat in total butter.
				Water.	Fat.	Curd by dif.	
		Lbs.	Ozs.	Per cent.	Per cent.	Per cent.	Ounces.
1	Clothilde	2	7½	21.06	77.55	1.39	30.63
2	Clothilde IV	2	¼	17.82	81.51	.67	26.29
3	Gold Lace	1	14½	14.55	84.52	.93	25.78
4	Jessie of Lester Manor	1	14½	15.23	84.05	.72	25.64
5	Mechtchilde	1	14	22.19	76.75	1.06	23.02
6	Lady Fay	1	10¼	17.01	81.98	1.01	21.52
7	Island Chrissie	1	8¾	15.43	83.65	.92	20.70
8	Hilda A. III	1	9¾	20.80	78.33	.87	20.17
9	Movike	1	2¾	16.45	82.98	.57	15.56
10	Water Lily		14½	17.14	82.20	.66	11.92

The total amount of fat in the butter, as shown by these figures, justifies the award of the prize. It is evident, however, from the variable amount of water in the butters, that had the yield been more nearly equal, this would not have been the case. Obviously the only true basis for a test of this kind is the amount of fat which the butter contains, and I trust that the time is not distant when no butter test will be accepted unless accompanied by an analysis of the butter made. I would go still further, and analyze the milk given, as this, in connection with the analysis of the butter produced, would be the best guarantee against fraud, and would render unnecessary the locks and seals with which such tests are at present encumbered. With the adoption of this plan each person can manage his milk as he chooses, knowing that any addition of fat to the milk or cream would be sure of detection. It would also prevent the suspicions which are often expressed, and I believe too often justly, that notable records are obtained by weighing undue quantities of water and curd as butter.

Besides the individual butter from the cows entered for the sweepstake prize, fourteen samples of the exhibition butters, including several of the prize packages, were obtained for analysis. These samples, coming from all parts of the country, should fairly represent the composition of prime American butter. The analyses are presented below:

NUMBER.	Water, per cent.	Fat, per cent.	Ash (salt), per cent.	Curd by dif., per cent.
1	9.32	87.32	2.34	1.02
2	11.91	85.03	2.17	.89
3	11.57	86.98	.96	.49
4	11.81	86.30	1.16	.63
5	9.76	86.99	2.31	.94
6	11.00	84.39	4.23	.38
7	10.50	86.87	2.29	.34
8	9.90	87.79	1.74	.57
9	11.80	85.32	2.42	.46
10	10.31	87.03	2.24	.42
11	9.26	87.57	2.21	.96
12	10.69	87.87	1.06	.38
13	10.47	87.55	1.46	.52
14	13.16	83.19	3.29	.36
Average	10.82	86.44	2.13	.60
Highest	13.16	87.87	4.23	1.02
Lowest	9.26	83.19	.96	.34

In addition to the ordinary analyses of these butters, which are given above, the filtered fat from each of them has been subjected to several of the tests that have been proposed by chemists for the detection of adulterations. These tests are especially interesting, as each of them depends upon some peculiarity of the butter, and in a measure indicates its composition.

The tests made have been the volatile fatty acids by Reichert's method, the saturation equivalent by Koettstorfer's method, the iodine number as proposed by Hubl, the melting point of the butter fats and the viscosity of aqueous solutions of the potash soaps, as described in the report of the New York Agricultural Experiment Station for 1886. The results obtained are presented in the accompanying table, the butters being arranged according to breed of cow so far as this was known:

	Number.	Reichert's test—N-10 Na O H.	Hubl's test—Iodine number.	Koettstorfer's test—Milligrams of K O H for 1 gm. of fat.	Melting point.	Viscosity of soap solutions.
Jersey butters	1...	16.1	34.5	227.5	32.7	103
	2...	14.1	30.5	227.1	35.3	54
	3...	13.2	35.3	229.8	33.7	71
	4*..	14.1	32.6	231.1	33.8	81
	5*..	11.5	35.6	223.1	33.2	97
	6*..	13.2	25.9	232.5	35.4	50
	7*..	14.4	23.8	232.2	34.0	65
Average	....	13.8	31.2	229.0	34.0	74
Holstein butters	8...	16.1	41.4	224.0	34.6	297
	9...	12.5	41.0	220.5	34.9	256
	10*..	14.4	44.7	224.3	32.1	461
	11*..	14.1	40.1	226.8	32.4	179
	12*..	13.9	42.2	227.6	30.5	187
	13*..	12.1	34.6	222.7	36.9	166
	14*..	16.0	36.1	229.4	32.4	112
Average	....	14.1	40.0	225.0	33.4	237
Guernsey butters	15...	15.6	36.9	227.2	33.5	153
	16*..	14.3	33.9	232.0	33.0	68
Ayrshire butter	17*..	13.9	37.8	232.3	33.5	66
Breed unknown	18...	13.3	35.4	227.8	33.5	71
	19...	12.9	41.2	222.3	33.0	208
	20...	13.9	33.3	227.2	34.6	65
	21...	14.1	33.8	227.8	33.5	65
	22...	14.2	32.8	228.0	35.0	100
	23...	13.4	33.3	228.5	34.4	88
	24...	13.5	39.2	224.8	33.2	103
	25...	14.1	31.9	228.0	35.0	62
	26...	13.9	37.8	232.3	33.5	66
Average	....	13.9	35.6	228.2	33.8	93
Average for 26 samples	....	13.95	35.6	227.5	33.7	127

* Butters from the milk of single cows.

I shall consider the relation which the figures given by these tests bear to the chemical composition of the butter fats; the difference in the composition indicated which may be attributed to breed and to individuality of cow, and finally the bearing which these variations have upon butter standards and the detection of adulterations.

I. VOLATILE FATTY ACIDS — REICHERT'S TEST.

The principal distinction between butter and other fats is found in the presence in butter of a considerable amount of glycerides of volatile fatty acids. The acids of this class which have been identified are butyric, capric, caproic, and caprylic; of these the first largely predominates and it is customary to consider all of the volatile acids as butyric. Reichert's test depends upon the amount of these volatile fatty acids which are obtained in a specified manner from 2.5 gms. of fat. It is expressed by the numbers of cubic centimeters of decinormal alkali required to neutralize this acid. The alkali required is not an equivalent for the total volatile acid of the butter, although it appears to have quite a uniform ratio to them. Waller's results show that the figures obtained by Reichert's test represented about 80 per cent of the total volatile acids expressed as butyric. (N. Y. Dairy Commissioner's report, 1886, p. 240.)

While these butters differ widely in the amount of volatile acids, there seem to be no differences which can be attributed to breed; the average and extreme figures for the Jerseys, Holsteins and others being nearly the same. The extreme variation is from 11.5 c. c. to 16.1 c. c., the average for all determinations being 13.95 c. c. Reichert gave the mean value as 14 c. c., the lowest limit for pure butter being placed at 12.5 c. c. All of these samples except Nos. 5 and 15 fall within these limits. These butters, so exceptionally low in volatile fatty acids, were tested several times and always with practically the same results. These low results cannot be attributed to breed and are probably not due to food, as the dairy butter No. 2, which is above the average, is from the herd to which the single cow No. 5 belonged. The only other case in which figures so low as these have been obtained, from butter known to be pure, is mentioned by Cornwall and Wallace (Zeit. Ann. Chem., Heft 3, 1887), who found in a sample of butter made from milk of a grade Alderney 11.3 c. c.–11. 5 c. c. These tests extended over a period of several weeks and were repeated many times by each of the investigators. This exceptionally low figure could neither have been due to breed nor to food, as this cow belonged to a herd of eight of the same breed, all receiving the same care, the remaining cows of the herd ranging from 12.2 c. c. to 15.1 c. c.

Reichert's method has been quite generally adopted by chemists for the detection of adulteration, and for this purpose is probably the most satisfactory that has been proposed. It appears, however, from figures given above, and others which might be cited, that the lower limit adopted is too high. Certain it is that some pure butters, and especially those from single cows, may fall considerably below 12.5 c. c.

2. IODINE NUMBER.

Oleic is the only fatty acid found in the glycerides of butter fat which has the property of absorbing iodine. Each molecule of this acid absorbs one molecule of iodine, so that the per cent of iodine absorbed is directly proportional to the per cent of olein present. The variation of this number, especially in the butters from single cows, is very great, showing the per cent of olein to vary in these butters from 27.7 to 52.1. There is also a very decided difference between the Holstein and other breeds, the average for the Holstein being olein 46.19, that for the other cows tested being 35.4 per cent. The average for 26 samples of butter, including that from single cows and dairies, has been olein 41.5 per cent. This high per cent of olein in Holstein butter will account for its softness as compared with Jersey butter.

The wide range in the iodine number shows olein without doubt to be the most variable constituent of butter. This, in connection with the variation due to breed, is sufficient to render the test useless for the detection of adulterations. It is, however, of value as an indication of the composition of butter.

3. SATURATION EQUIVALENT — KOETTSTORFER'S METHOD.

The volatile fatty acids of butter have a much lower molecular weight than stearic, oleic or palmitic; consequently butter requires more alkali for saponification than fats which contain only the latter acids. Thus lard, tallow and the oils used as adulterants, all require less than 200 milligrams of potassium hydrate for each gram of fat, while butter requires from 220 – 232 milligrams.

By comparing the figures for the above butters we find that the Holstein butters quite uniformly require less potassium hydrate for saponification than do the Jersey butters. This, taken by itself, indicates that the Jersey butters contain a larger proportion of volatile fatty acids than the Holstein. Reichert's test, however, does not confirm this. It seems, therefore, that the insoluble fatty acids of Holstein butter must consist on the average of fatty acids of higher molecular weight than Jersey butter. In other words, if the insoluble fatty acids of butter are a mixture of oleic, stearic and palmitic, the proportion of oleic and stearic acids must be larger in Holstein than in Jersey butter.

Blythe gives the percentage of the different glycerides of butter as follows:

Olein	42.2
Stearine and palmitine	50.0
Butyrine	7.8

If we consider the stearine and palmitine as present in equal quantities, the milligrams of potassium hydrate required for saponifying 1 gm. of this typical butter would be 222.8. This is considerably less than the average obtained from pure butters. Assuming stearine as absent and replaced entirely by palmitine there would be required only 227.6 mgr. potassium hydrate for 1 gm. of fat. This is about the average for butter and is considerably less than the highest limit found. This would indicate either that the olein of butter has been overestimated, or that there is present in butter glycerides of other fatty acids of lower molecular weight than those which have been mentioned, or that stearine in most butters is absent. The iodine numbers for the 26 butters in the tables show an average per cent of olein 41.5, or very nearly that mentioned by Blythe.

If we assume that in Reichert's method 75 per cent of the volatile fatty acids are recovered, we have a means for calculating approximately the composition of these butters. The iodine number gives data for obtaining the olein, so that there is left the stearine and palmatine to neutralize the remainder of the potassium hydrate required for saponification. An attempt to apportion the K O H remaining between stearine and palmatine, shows that in many of these butters the potash is in excess even if stearine is absent. This indicates that either stearine is present in small quantity or that insoluble acids of lower molecular weight than palmatic are present in considerable quantity.

4. MELTING POINTS.

The melting points given for these butters were determined in the manner proposed by Wiley, by means of disks of fat suspended in a mixture of alcohol and water and noting the temperature when the disks assume a spherical form. Wiley says (Bulletin of Dept. of Agriculture No 13, p. 49): "The mean melting point of the butters examined is 33.8° C., the maximum is 34.7° C, and the minimum 32.6° C. In general terms, it may be said that a genuine butter will show a melting point falling within the limits of 33 C. and 34 C." Although the average found in the above butters is nearly the same as the mean given by Wiley, being 33.7° C., the extremes are much wider, viz., from 30.5 C. to 36.9° C. This, however, is only true of the butters from single cows, as the butters from herds fall nearly within his limits, the average being 34 C., ranging from 32.7 C. to 35.3 C.

These results vary greatly in the butter from individual cows, but are not sufficiently marked between the breeds to show that variation may be attributed to this cause. They are, however, sufficient to render this determination useless for the detection of adulteration. Although the Holstein butters are much softer than the Jersey butters when exposed to warmth, they do not appear to become liquid at a perceptibly lower temperature.

5. VISCOSITY OF SOLUTIONS OF BUTTER SOAPS.

Aqueous solutions containing 4 or 5 per cent of potash soaps become, when rendered slightly alkaline with potassium hydrate, quite viscous, and when the amount of free alkali is considerable, are completely gelatinized. Each of the fatty acids, stearic, oleic, etc., which enter into the composition of fats and oils, forms with potash a soap whose aqueous solution has a definite coëfficient of viscosity. Solutions of these soaps behave differently with potash, stearic and oleic acid forming soaps whose solutions are more easily gelatinized than the soaps of other fatty acids found in ordinary fats and oils. It follows that solutions of soap with a definite amount of potash from different fats will be more viscous in proportion as these acids predominate in the fats used. The salts of the volatile fatty acids are but little influenced by potash. This is also true of palmitic and the other acids of butter except oleic and stearic. It is evident, therefore, that the determination of viscosity of soap solutions, made under the same conditions, furnishes a means of discriminating between different fats and oils. Especially is this true when applied to butter and its substitutes, as those fats used for the adulteration of butter are composed almost entirely of glycerides of stearic and oleic acid. A soap made from 15 grams of stearic or oleic acid, with 10 gms. of potassium hydrate, dissolved in water and made up to 500 cc., will form at 20° C. a very viscous solution; it is indeed almost a jelly. Lard, tallow, cottonseed or olive oil and all of the common fats and oils act in a similar way. The same is true of butterine, oleomargarine and all of the commercial substitutes of butter. Butter, on the contrary, when treated in this way, gives a limpid solution, the viscosity of which is very slight. Butters, however, on account of the variation in the amount of volatile acids and olein, have a very wide range, so that small quantities of foreign fats when mixed with butter may not be detected. The volatile fatty acids of butter tend in two ways to reduce the viscosities of its soap solutions. First through their low coëfficient of viscosity, and second through their comparatively high neutralizing power, which leaves less alkali in solution.

The tests of the Dairy Show butters show these variations in a most satisfactory manner. They indicate clearly breed peculiarities and variation in the composition of butter from single cows not shown by other methods. The viscosities given are expressed by the number of grams of cane sugar, which, dissolved in water and made up to 1 litre, give solutions having the same viscosity as the liquid under examination. The thoroughbred Holstein butters, 7 in number, have an average viscosity of 237, ranging from 112 to 461. Seven thoroughbred Jersey butters averaged 74, ranging from 50 to 103. Of other thoroughbred butters, the Guernseys are represented by two and the Ayrshires by one sample. These are insufficient to show breed peculiarities which may exist, and are classed with those from grades and unknown sources. The average viscosity of these unknown butters is 93, ranging from 65 to 208.

The general average for all of these butters is 127, ranging from 50 to 461. This average, however, owing to the large number of Holstein butters, is too high. The average for commercial butters throughout the country will probably not exceed 100.

An inspection of the figures shows the viscosities to vary quite uniformly with the iodine numbers, or, in other words, with the percentage of olein which the butters contain. Tests with commercial oleic acid, probably not pure, show that the quantity of oleic acid found in butter by the absorption of iodine, when saponified and dissolved in water containing the same amount of free alkali as the butter soap solutions, will have nearly the same viscosity as those solutions. This indicates that stearic acid is either entirely absent in butter, or present in very small quantities ; and fully confirms, in an independent manner, the conclusions reached by comparison of the saturation equivalents of different butters. It is of course possible that the volatile and other fatty acids of butter having a low molecular weight may modify the viscosities due to oleic and stearic acids, thus rendering the coëfficients of viscosity of these acids, taken together, less than they would be if alone. This, however, is not probable, as a mixture of the fatty acids of butter, so far as they could be obtained, and glycerine, in the proportions given by Blythe as existing in butter, when saponified, gave a solution whose viscosity was too great to be measured by the apparatus, as arranged for butter.

For the detection of adulterations in butter, and probably in other fats, the determination of viscosity of the soap solutions is a rapid method, easy of manipulation, and as efficient as any of the chemical methods in general use. The range in the butters from single cows appears much greater than that shown by other methods. This difference, however, means no more in per cent of adulteration than do the smaller differences shown by Reichert's or Koettstorfer's method; for all of the commercial adulterations, such as oleomargarine or butterine, which rarely contain less than fifty per cent of adulteration, the results are never doubtful. In any known sample of butter the addition of one per cent of lard, oleomargarine or cottonseed oil is easily detected. The readiness with which slight changes in the composition of butter may be shown renders this examination of value in feeding experiments, for determining the effect of foods upon the butter fats.

CONCLUSIONS.

The variations in the composition of butter, as shown by these examinations, are much greater than has been generally supposed, and occur not only in the amount of volatile fatty acids, but affect all of the constituents of the butter.

These variations are especially marked in those butters made from the milk of single cows, where the extreme values are so widely separated as to render doubtful the detection of even thirty per cent of adulteration by means of any single test. It is, however, unlikely that a pure butter will be found deficient in all respects, so that in doubtful cases the application of as many tests as possible is advisable.

The influence of breed of cow upon the composition of the butter fat is no less marked than it is upon the composition of the milk, and, contrary to general acceptation, does not appear to be materially affected by the character of the food.

The amount of stearine in butter has been largely over-estimated; instead of thirty to forty per cent it is probably less than three per cent in most butters. It is only on this supposition that the high saturation equivalent of butter fat, and the low viscosity of solutions of its soaps, can be explained.

THE USE OF THE VISCOMETER.

The experience of another year with the viscometer has confirmed my impressions, given in the last annual report, concerning its value as an aid in the study of butter and other fats. For the detection of adulterations in fats and oils, the method proposed is as reliable as any of the chemical methods in general use, and has the advantage over most of them that it requires comparatively little time. As some slight changes have been made in the manner of conducting the test, the method as applied to the examination of butter is described in full.

Fifteen grams of the filtered butter fat are weighed into a beaker of about 500 cc. capacity, and 10 cc. of a solution of potassium hydrate (1 cc. = 0.5 gm. K O H), and 10 cc. of 95 per cent alcohol added. The beaker is placed upon a water bath and heated, the contents being occasionally stirred, until saponification is complete and the alcohol evaporated. About 300 cc. of water are then added and warmed until the soap is completely dissolved, the beaker meanwhile being covered to prevent the formation of a film over the surface of the liquid. When the solution is clear, 10 cc. more of the potassium hydrate solution are added, the beaker being left upon the water bath till the precipitate which forms is dissolved. The same results will be attained by adding 20 cc. of the potassium hydrate solution at once to the fat before saponification, but in this case the soap formed will be difficultly soluble and considerable more time will be required in making the solution. The soap solution is transferred to a 500 cc. flask, which is then filled to the mark with water. The solution is cooled to 20 C., the volume accurately adjusted to 500 cc. and its viscosity determined.

When treated in this way each of the fatty acids, stearic, oleic, palmitic, etc., which enter into the composition of fats and oils, forms a soap, the solution of which has a definite coëfficient of viscosity. Moreover, this coëfficient of viscosity is increased in a manner peculiar to each of these acids by the addition of alkali to the soap solutions. It follows that any changes in the composition of the natural fats and oils will be indicated, either by changes in the viscosity of the soap solutions or by the effect produced by the addition of definite quantities of alkili (K O H). The soaps from fatty acids of high molecular weight, as stearic and oleic, have a high coëfficient of viscosity, while those from acids of low molecular weight, as butyric and caproic, have low coëfficients of viscosity. This is partially due to the difference in the neutralizing power of the acids, the soap solutions from acids of high molecular weight being more alkaline than the others, but this only accounts for a part of the difference, as even when the solutions are made to contain the same amount of free alkali a marked difference still exists. As a considerable portion of the fatty acids of butter have a low molecular weight, the viscosity of its soap solution is low when compared to that from the fats and oils which are used for its adulteration. For instance, the average viscosity of solutions of soaps from butter fat is about 100; that of lard, tallow, oleomargarine oil and all of the commercial substitutes for butter are upwards of 1,000, so that this test is amply sufficient for this discrimination. Butters, however, vary greatly in composition, and consequently there is a wide range of viscosity for the solutions of butter soaps. This range is so great that over 30 per cent of adulteration may be added to the butter giving the least viscous soap solution before the higher limit for butter is passed. This at first seems sufficient to condemn the method, but an examination of the tests for adulteration, which are generally accepted by chemists, shows them to be no more reliable than the test proposed, while most of them are more complicated and difficult of manipulation. I give below extreme figures which I have myself found by Reichert's and Koettstorfer's test, and in connection with them the amount of lard of average composition which must be added to the butter giving the highest figure to reduce it to the lowest:

	Maximum.	Minimum.	Per cent of lard necessary to reduce max. to min.
Reichert	17	11.3	33.6
Koettstorfer	233	220	34.2

The methods mentioned in this table are the ones most generally employed by chemists for the detection of adulterations. I believe, therefore, that the viscosity test is fully as reliable for this purpose as any which has been proposed.

The real difficulty lies not in any of the proposed tests, but in the variable composition of butter, that from different breeds, and even from single cows of the same breed, having very different properties. It is not probable that the butter from herds and creameries where the milk of a large number of cows is received, would give figures by any of the above tests which differ much from the average. Still the possibility always exists that a sample of butter which gives the minimum test may or may not be pure, and I believe that no single test is competent to discriminate absolutely between some pure butters and others which contain as much as 30 per cent of adulteration. On this ground I would urge upon chemists the necessity of applying as many tests as are available in all cases where doubtful figures are obtained. The tests which I would recommend for the detection of adulteration are first, on account of the economy of time and ease of manipulation, the viscosity test as described above, and second, Reichert's test.

The combination of these two tests, depending as they do upon entirely different properties of the fats, will in nearly all cases be sufficient. Should the viscosity exceed 500 there is no doubt of its adulteration, and no further test need be made. Butters giving viscosities between 200 and 500 are doubtful and should be submitted to further examination.

It is probable that the viscosity of soap solutions from butter diminish with age. Seven samples of butter tested in May, shortly after churning, were tested again in October with the results given below. These butters were filtered at the time of first test and kept in corked bottles until tested again; they were at this time slightly bleached, but were otherwise unchanged in appearance.

Viscosity in May	65, 69, 62, 61, 69, 68, 65;	average 65.6
Viscosity in October	54, 62, 62, 58, 53, 62, 54;	average 57.9

In the last report I have recommended the determination of viscosity as a rapid and efficient means for detecting changes in the composition of milk which may occur from day to day, and have suggested that it might, to some extent, replace analyses of milk during feeding experiments. The data obtained at that time seemed to warrant this conclusion. Later tests, however, in the same series, showed that changes in the milk may be of such a nature as to cause no change in its viscosity. This is shown in the following determinations where milks having the same viscosity differ considerably in composition:

Viscosity	288	Fat	5.74
Viscosity	288	Fat	5.62
Viscosity	288	Fat	4.71
Viscosity	273	Fat	5.55
Viscosity	273	Fat	4.89
Viscosity	266	Fat	4.85
Viscosity	266	Fat	4.42

It is evident, therefore, that the test does not accomplish all that I hoped it would one year ago. Still it has a value, especially when accompanied by analyses, as it will indicate changes in the physical constitution of milk which are often of more importance to the dairyman than are changes in the amount of solids or of fat. Changes in the size of the fat globules or in the viscosity of the milk serum are of this nature and are not indicated by chemical analysis. A low viscosity of the milk serum, accompanied by large fat globules, supplies favorable conditions for the economical production of butter. As the coëfficient of viscosity for the fat of milk increases with the size of the globules, it follows that the greater the difference between the viscosity of the whole milk and that of the skim-milk the more valuable will the milk be for butter, provided, of course, that the viscosity of the skim-milk is not very high.

When warm milk is run through a centrifugal, the skim-milk and cream being caught in the same vessel and thoroughly mixed, the product is less viscous than the original milk. This appears to be chiefly due to the breaking up of the fat globules. The extent to which this division takes place is shown by the following determination of the number of globules before and after separation:

	Viscosity.	Number of globules in .0001 c. m. m.	Per cent of globules with diameter less than one division of micrometer.
Milk	267	149	52.7
After separation	248	201	60.3
After second separation	249	174	70.0

The second separation was effected at too low a temperature and resulted in partially churning the cream. Under the microscope many of the fat globules appeared distorted and adhered to each other; this partially accounts for the smaller number of globules and increased viscosity found after this separation. Although the per cent of small globules after the second separation is considerably increased, their number remains almost exactly the same as before, showing that in the process of churning the large globules are the ones which first unite to form granules of butter.

The effect which this division of the fat globules has upon the quantity and quality of butter made from centrifugal cream is at present uncertain, no direct tests having been made. This peculiarity, however, may explain why the same manipulation which produces high-grade butter from ordinary cream often fails when applied to centrifugal cream.

The hypothesis that the butter fats are derived directly from the food, and are transferred without change to the milk, as advanced by

Professor Arnold,* has received considerable attention, and is worthy of careful investigation, as its confirmation would enable the dairyman to control, through the food, the quality and composition of the butter produced. There is asserted evidence that such a transfer takes place in the well-established fact that certain plants, as onions, turnips, etc., when fed to milch cows, impart, in a short time, their characteristic odors to the milk. The marked difference not only in color but in flavor of butter made during the winter, when the cows receive only dry food, and in the summer, when in pasture, has been attributed to differences in the fatty portions of the fodder.

On the other hand, the variations in the composition of butter to be ascribed to breed, and to individual peculiarities of the cow, are so well defined and so constant in character, whatever the character of the food given, as to render a direct transfer of fats highly improbable. That the essential oils of plants may to a small extent be transferred to the milk without decomposition, need not be here questioned. These principles, however, being volatile and somewhat soluble, should be more readily assimilated than the insoluble fixed oils such as comprise a large proportion of butter fats. Moreover, the proportion of these essential oils of the food which finds its way into the milk is very small. A peck of onions fed to a cow would scarcely impart so much flavor to the milk as would a small piece added directly to it.

One way of solving this question is by careful examinations of the butter and noting the changes in composition which follow radical changes in the food. Crude cottonseed oil has some characteristic properties by which its presence, when mixed with butter, even in small quantities, may be detected. This fact suggested the experiment of feeding cottonseed meal, which contains a high percentage of oil, and which is generally conceded to have a decided influence upon the character of the butter, to a cow, and examining the butter for the peculiar properties of cottonseed oil. This test was made with one of the Station cows, the butter from which had been previously and frequently tested in the laboratory.

The first cottonseed meal was fed April eighteenth, one-half pound being given. This quantity was gradually increased until May first, when four pounds were fed each day. This amount of meal contained as much fat as the remainder of the ration, and would, therefore, be expected to contribute an appreciable amount of cottonseed oil to the butter, if any direct transfer occurred.

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* Paper read at the meeting of the Society for the Promotion of Agricultural Science at Montreal.

The tests applied to the butter were viscosity of its soap solutions and its behavior when mixed with subacetate of lead. The first of these tests is very sensitive to changes in the composition of butter fat. Moreover the soaps from crude cottonseed oil have a high viscosity, while those from butter fat are usually low.

The butter from the cow experimented with was tested February 25; April 18, 22, 26, 28; May 4, 8, 16, and October 21, with the following results :

Date	Feb. 25.	April 18.	April 22.	April 26.
Viscosity	65	69	62	73

Date	April 28.	May 4.	May 8.	May 16.	Oct. 21.
Viscosity	61	69	68	65	68

Feb. 25, when the first test was made, the cow was being fed ensilage, with some hay and corn meal. For two weeks preceding April 18 she was fed hay with corn meal and wheat bran. From this time until into May she received hay with a gradually increasing quantity of cottonseed meal. The uniformity of this test, before, during and after the experiment, shows that very little change in the composition of the butter had occurred under decided changes in the character of the ration, and is strong evidence that no cottonseed oil was transferred to the butter. This will be more apparent when it is considered that the viscosity of soap solutions from butter of different cows under normal conditions has varied from 50 to over 400.

When cottonseed oil is thoroughly mixed with a strong solution of basic acetate of lead, and allowed to stand for some time, it changes to a peculiar brownish red color.* This reaction is said to be characteristic of this oil and serves to detect it when mixed with other fat. Pure butter fat treated in this way remains unchanged in color, but the addition of a small quantity of cottonseed oil causes it to assume a yellow, and if a large quantity is present a brown color. None of the butters made from this cow at any time, whatever her feed, were affected by this test.

The negative results of these two tests show beyond question that, in this case at least, there was no transfer of cottonseed oil from the food to the milk. The same thing is shown by the constant and uniform difference found in butters from different breeds of cows and from individual cows in the same herd, all receiving the same food and care. These considerations and the general impressions of all of my work with butter have led me to believe that the composition of the butter fats are practically constant for each individual cow under all circumstances of normal feeding.

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* Zeit. fur Chem., XXII, p. 618.

Must we then conclude that neither care of cow nor food can influence the quality of butter? Not at all; quality of butter depends more upon certain physical properties and flavors, which comprise scarcely more than traces of the butter, and which as yet have not even been identified by chemists, than upon the fixed oils which compose it. These principles, and also those which determine the color of butter, are unquestionably influenced by food and treatment. I believe, however, that the first and most essential requisite in the manufacture of good butter is a butter cow. Without this one factor, success is impossible; with it and a skilled dairyman, success is certain and practically independent of the character of the ration fed, if sufficient nutriment is supplied.

LYSIMETER.

Each year since the establishment of this Station, in 1882, records have been presented in the annual reports, of the monthly drainage water from each of the three lysimeters and of the chemical examinations made. Discussion of results has been deferred, hoping that sufficient data would reconcile the discrepancies which exist between the lysimeter results and what apparently takes place in outside soils. Increased data has not done this, and I am inclined to believe that no analogy exists by which evaporation, drainage and consequent loss of fertility in natural soils can be determined by lysimeters constructed in the ordinary way.*

Before discussing our lysimeter results and the causes which are believed to render them unsatisfactory, I wish to consider the evaporation which takes place from large areas under natural conditions. For this purpose I assume that the difference between the rainfall upon a given water-shed, for a series of years, and the water which is discharged by the drainage streams, represents the evaporation. Unfortunately, there are but few water-sheds which have been studied with sufficient accuracy to be available for this purpose, but the discharge of streams which are depended upon for the water supply of cities have been quite closely determined.

The data given in the following table are compiled from the reports of the Boston Water Board and from the Tenth Census of the United States, Vol. XVI:

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*See N. Y. Agr. Exp. Station report for 1882, p. 14.

WATER SHED.	Years of record.	Mean annual rainfall, inches.	Mean annual discharge, inches.	Difference or evaporation, inches.
Lake Cochituate.....	29	49.11	22.08	27.03
Sudbury river.......	6	46.10	21.93	24.17
Mystic river........	5	42.78	19.65	23.13
Croton river........	13	46.64	26.35	20.29

Professor Geo. F. Swain* says: "It has been found by the experience of cities in regard to their water supply and by continued gauging of streams, that in very dry years in this climate, the total amount of rainfall discharged by streams falls as low as from twelve to fifteen inches over the entire drainage basin." He also states from data derived from the Smithsonian tables that the minimum rainfall is about seven-tenths of the mean. The average rainfall for the section under consideration is over forty inches, and the minimum rainfall is rarely below thirty-five inches. Calculations based upon these figures, and upon the assumed discharge of a large number of streams, indicate that throughout the Eastern and Middle States the evaporation for large areas, except in rocky and mountainous regions, is scarcely ever less than twenty inches, and in most localities considerably exceeds this.

What the effect of a diminished rainfall for a series of years would be is not evident; it is quite certain, however, that it would diminish the amount of water discharged by streams to a greater extent than it would diminish the evaporation. This is well illustrated by results obtained on streams from which the water supply of Boston is derived, for the years 1879 and 1880, which were exceptionally dry. In the following table is given the rainfall and amount of water discharged for these two years for the basins of Lake Cochituate, Sudbury and Mystic rivers:

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* Report of Water-Power of Eastern New England, Tenth United States Census, Vol. XVI.

		Rainfall, inches.	Water collected. inches.	Evaporation, inches.
Lake Cochituate....	Ave. 29 y'rs.	49.11	22.08	27.03
Lake Cochituate....	1878.......	53.58	26.25	27.33
Lake Cochituate....	1879.......	38.01	17.86	20.15
Lake Cochituate....	1880.......	35.83	10.30	25.53
Sudbury river.......	Ave. 6 years	46.10	21.93	24.17
Sudbury river.......	1878.......	57.93	30.49	27.44
Sudbury river.......	1879.......	41.42	18.77	22.65
Sudbury river.......	1880.......	38.18	12.49	25.69
Mystic river.........	Ave. 5 years	42.78	19.65	23.13
Mystic river.........	1878.......	54.06	25.79	28.27
Mystic river.........	1879.......	35.30	17.61	17.69
Mystic river.........	1880.......	34.42	12.28	22.14

It will be seen that the year 1878 was marked by an exceptionally large precipitation, to the influence of which may be atttributed the apparently low evaporation of the following year. The rainfall for the year 1880 was less than any previously recorded on this basin, and although the previous year was dry, the apparent evaporation differs but little from the mean.

The Oswego basin, to which this locality must be assigned, receives an average of about thirty-five inches of rainfall per year. Calculations based upon the assumed discharge of the river show an average discharge of less than fourteen inches, leaving about twenty-one inches as the probable evaporation for the whole water-shed. But a portion of this basin, which includes the vicinity of this station, extending from Geneva to Penn Yan, receives on the average less than thirty inches of rainfall, and some years but little more than twenty inches. This is less than is reported from any other section of the United States east of the Mississippi valley. The average rainfall at the New York Agricultural Experiment Station for four years, 1883-1886 inclusive, was twenty-five inches. The average for other points in this basin, as shown bv the Smithsonian records, is as follows:*

	Number of years' observation.	Average rainfall, inches.
Penn Yan..............................	39	28.31
Ithaca.................................	19	34.54
Rochester..............................	45	33.65
Syracuse...............................	9	36.75
Oswego.................................	18	40.42

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* Tenth U. S. Census, Vol. XVI.

As the proportion of the rainfall evaporated is greatest during the summer, the monthly distribution of the rainfall has an important bearing upon the annual evaporation. Nearly all of the data which have been cited in regard to the rainfall and evaporation have been derived from stations along the Atlantic coast, and especially from the region which contributes to the water supply of Boston. For the purpose of comparing the distribution of the rainfall in those sections with that in this immediate vicinity, the following table, showing the ratio of the monthly rainfall to the mean monthly rainfall, is given. The figures for the Atlantic seaboard are the mean of 18 stations distributed along the coast from Maine to Washington. They are for a series of years, none of the stations having less than 20 years of record. These, with the figures for Boston and Penn Yan, were taken from the Tenth U. S. Census, Vol. XVI, for which they were compiled from the Smithsonian records:

	Atlantic seaboard.	Boston, 28 years.	Penn Yan, 39 years.	N. Y. Agr. Exp. Station, Geneva, N.Y., 5 years.
January	0.92	1.00	0.58	0.47
February	0.84	0.94	0.61	0.81
March	0.96	0.98	0.70	0.52
April	1.00	1.04	1.01	0.93
May	1.13	1.10	1.29	1.10
June	0.96	0.89	1.42	1.36
July	1.01	1.08	1.33	2.10
August	1.22	1.10	1.19	1.53
September	0.92	0.94	1.16	0.99
October	0.96	0.89	1.10	0.89
November	1.02	1.03	0.89	0.88
December	1.06	1.03	0.71	0.42

An inspection of this table shows a much greater proportion of rainfall during the summer months in this section than along the Atlantic coast. The per cent of the total annual rainfall received during five months from May 1 to Oct. 1 is, for the Atlantic seaboard 43.67, for Boston 42.57, for Penn Yan 53.25, and for N. Y. Agr. Exp. Station 59.0. In consequence of this large proportion of rainfall during the summer, the proportion of rainfall evaporated must be greater in this locality than in the sections which have been referred to. Taking this into consideration, it is probable that even with the small rainfall received here the evaporation is not much, if any, less than 20 inches.

All of the data given indicate that this section is one where drainage (percolation) is very small, and where the evaporation is nearly equal to the water which actually enters the soil, the water discharged by the streams being mostly derived from the flood waters of heavy showers in summer and from melting snows in spring, which have never entered the soil. It is impossible from any data now at hand to determine the flood water, but that it is considerable is shown by the volume of water discharged by streams during freshets. It probably amounts in this locality to four or five inches per annum.

In our lysimeters, where all of the water falling upon the surface is compelled to enter the soil, and where exceptionally good drainage is provided, the drainage water cannot be much in excess of the flood water, and in lysimeter No. 1 is no doubt less. Owing to the facility with which surplus water drains from the lysimeter soil, this soil is liable to become abnormally dry, and being cut off from the natural water-table, redistribution of moisture by capillarity does not occur to the same extent as in natural soils. This tends to reduce evaporation from the lysimeters below the average, but its effect is to some extent offset by the larger amount of water which the lysimeter soils absorb, so that the total evaporation from the lysimeters may approximate to that from soils outside. It is probably less in quantity, and when expressed in per cent of the water which enters the soil must be very much less. The drains which pass through the experimental plats deliver very little water during the summer months, and the soil is apparently dryer at the end of the season than in the spring, indicating what I believe to be true, not only for this, but for most localities devoted to agriculture, that during the warm months evaporation considerably exceeds the rainfall which enters the soil. I believe, moreover, that throughout the whole season the evaporation from agricultural lands nearly equals the rainfall which directly enters the soil. Most of the water which penetrates the soil to the level of the water-table is precipitated during the winter months, when the surface of the soil is frozen, and much of it enters the ground through crevices without leaching. In consequence of this the water which reaches the lower strata of the soil carries with it very little of the soluble elements of plant food contained in the surface soil. This assumption is confirmed by the small quantity of those elements found in well and spring waters in most localities. On the other hand, there is a gradual and almost constant movement of water by capillarity towards the surface to supply that lost by evaporation, which tends to concentrate the soluble matters near the surface, where they are most available for plants.

In lysimeters, owing to the increased water absorbed by the soil, the good drainage, and the consequently diminished evaporation ratio, the movement of the water is in general downwards, and carries with it the soluble matters of the soil, which finally are lost in the drainage. In this respect a lysimeter acts as a leach which must eventually remove all soluble plant food from the soil, provided that the rainfall is sufficient to cause a moderate drainage. That this is what has occurred in our lysimeters is clearly shown by the amount of soluble nitrogen compounds annually removed in the drainage water. No. 1 in sod, is exceptional in this respect, but with this lysimeter the drainage has been generally small, and has mostly occurred during and immediately after storms, indicating that it was really flood water which had run directly through holes in the soil. In Nos. 2 and 3 the leaching is decidedly marked, and the gradual increase in the amount of nitrogen lost, confirms the opinion that the loss of nitrogen is due to this action. The comparatively small loss for 1887 may be due either to the small drainage or to previous partial exhaustion of soluble matters from the soil. The enormous loss of nitrogen in the drainage waters of Nos. 2 and 3 is in itself presumptive evidence that the indications of the lysimeter are misleading when applied to natural soils. This loss is more each year per acre than would be replaced by a ton of dried blood or of nitrate of soda, and is more than would be removed from the soil by twenty average crops of timothy hay. It would be absurd to apply these figures to ordinary soils, as such a drain upon its resources would speedily make any land sterile.

Although lysimeter results are greatly influenced by climate and the amount and distribution of the rainfall, the agencies described above are sufficiently operative in all localities to render figures derived from ordinary lysimeters useless for generalization.

In a new lysimeter, described in the report of the horticulturist, an attempt is made to eliminate one source of the discrepancies mentioned, by maintaining an artificial water-table at a known level. This lysimeter will give the amount of evaporation and drainage under known conditions, and may aid in the discovery of some law respecting the movement of soil water.

Tables are appended giving the rainfall, drainage and chemical examinations for each of the lysimeters for 1887, and a summary of results since January, 1883:

AMOUNT AND ANALYSIS OF DRAINAGE FROM EACH LYSIMETER FOR 1887.

LYSIMETERS.	Rainfall, inches.	Drainage, inches.	PARTS PER MILLION.				
			Solids.	Chlorine.	Nitrogen, as ammonia.	Nitrogen, as nitrates.	Total nitrogen.
No. 1. SOD.							
January	.18	.14	145.6	15.7	.069	tr.	.069
February	2.97	1.885	145.6	7.1	tr.	0	tr.
March	.48	.54	142.8	3.5	.044	0	.044
April	1.37	.52	137.1	7.1	tr.	0	tr.
May	.46	.035	120.0	7.1	0	0	0
June	2.01	00	0	0	0	0	0
July	6.37	00	0	0	0	0	0
August	3.03	00	0	0	0	0	0
September	.75	00	0	0	0	0	0
October	1.74	00	0	0	0	0	0
November	1.58	00	0	0	0	0	0
December	....	......	......	......	......	......	......
No. 2. BARE SOIL.							
January	....	.045	859.6	21.42	.055	122.21	122.265
February	....	1.477	711.1	7.1	tr.	135.36	135.36
March	....	.185	779.7	10.7	....	95.2	95.2
April	....	.14	848.2	10.7	.092	126.9	126.992
May	....	.04	1000.	10.	.185	120.	120.185
June	....	0	0	0	0	0	0
July	....	.140	805.4	5.7	.14	69.17	69.31
August	....	.695	662.6	7.1	.091	84.36	84.451
September	....	0	0	0	0	0	0
October	....	0	0	0	0	0	0
November	....	.3	7.20	7	123	85.348	85.471
December	....	......	......	......	....	......	......
No. 3. CULTIVATED SOIL							
January	....	.307	714.2	14.3	.078	113.2	113.278
February	....	1.400	457.1	4.3	.012	56.9	56.912
March	....	.790	391.4	tr.	.043	61.76	61.803
April	....	.530	445.7	7.1	tr.	64.33	64.33
May	....	.135	582.9	4.3	.10	74.32	74.42
June	....	0	0	0	0	0	0
July	....	.148	571.4	4.3	.089	51.46	51.549
August	....	1.055	662.8	4.3	tr.	55.16	55.16
September	....	0	0	0	0	0	0
October	....	0	0	0	0	0	0
November	....	4.	488	3	.1082	68.62	68.702
December	....	......	......	......	....	......	......

Monthly rainfall and drainage in tons per acre from each lysimeter, with the loss of nitrogen calculated in pounds per acre, from January 1 *to November* 1, 1887.

	Rainfall, tons per acre.	DRAINAGE, TONS PER ACRE.			LOSS OF NITROGEN, POUNDS PER ACRE.		
		No. 1, sod.	No. 2, bare soil.	No. 3, cultivated soil.	No. 1.	No. 2.	No. 3.
January....	20.34	15.82	5.08	34.69	0	1.24	7.86
February ..	335.58	212.98	166.88	158.19	0	45.18	18.03
March	54.23	61.01	20.90	89.26	0	3.98	11.03
April	154.80	58.75	15.82	59.88	0	4.02	7.70
May	51.98	3.95	4.52	37.85	0	1.08	5.63
June	227.12	0	0	0	0	0	0
July.......	719.74	0	15.82	16.72	0	.02	1.72
August.....	342.36	0	78.52	119.20	0	13.27	13.16
September..	84.74	0	0	0	0	0	0
October....	196.60	0	0	0	0	0	0

MONTHLY average of rainfall at the Station, and drainage from each of the three lysimeters from August, 1, 1882, *to November* 1, 1887, *inclusive*.

	Rainfall, inches.	DRAINAGE.							
		No. 1, SOD.		No. 2, BARE SOIL.		No. 3, CULTIVATED SOIL.		AVERAGE OF THREE LYSIMETERS.	
		Inches.	Per cent.	Inches.	Per cent.	Inches.	Per cent.	Inches.	Per cent.
January	.939	.289	30.8	.374	39.8	.351	37.4	.338	36
February	1.596	1.021	64.0	.831	52.1	.610	38.2	.821	51.5
March	1.030	.669	65.0	.687	66.7	.636	61.7	.664	64.4
April	1.834	.655	35.7	.968	52.8	.964	52.6	.862	47
May	2.180	.248	11.4	.598	27.4	.929	42.6	.592	27.1
June	2.710	.244	9.0	.287	10.6	.738	27.2	.423	15.6
July	4.146	.001	......	.742	17.9	.868	20.9	.537	12.9
August	3.032	.002	......	.629	20.7	.878	29.0	.503	16.6
September	1.952	.027	1.4	.493	25.3	.762	39.0	.427	21.9
October	1.733	.016	.9	.537	31	.611	35.2	.388	22.4
November	1.722	.192	11.1	.360	20.9	.846	49.1	.466	27
December	.850	.098	11.5	.442	52	.372	43.8	.304	35.8
Total average per year	23.724	3.462	14.6	6.948	29.3	8.565	36.1	6.325	26.6

Yearly rainfall, drainage and loss of nitrogen from January 1, 1883, *to November* 1, 1887.

	Rainfall, inches.	Drainage, Inches.			Loss of Nitrogen, Lbs. per Acre.		
		No. 1. Sod.	No. 2. Bare soil.	No. 3. Cultivated soil.	No. 1.	No. 2.	No. 3.
1883	25.89	3.748	8.248	11.509	......	......	......
1884	22.30	3.646	5.168	4.988	.2	69.5	132.2
1885	23.95	.357	7.088	10.989	1.02	218.7	218.2
1886	27.87	7.556	12.115	11.64	.08	357.7	234.1
1887*	19.36	3.435	2.722	4.365	0	68.79	65.13

SUNSHINE RECORD.

The daily record of sunshine, commenced May 4, 1885, was continued without break through 1886 and until September 8, 1887, when a change, not only in the location of the instrument, but also in the quality of paper used in it, rendered them untrustworthy, and observations were at that time suspended.

The total hours of sunshine for each month since the observations commenced and the daily record for the current year are presented. This record comprises only hours of bright sunshine, as our instrument fails to make a record in hazy or smoky weather, even when no clouds prevent.

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* To November 1.

SUNSHINE, 1887.

	Before 9 A. M.	9-12.	12-3.	After 3 P. M.	Total.
	h. m.	h. m.	h. m.	h. m.	h. m.
Jan. 1	......	......	......	......	....
2	......	......	......	......	....
3	–15	2–45	1–45	......	4–44
4	1–15	2–15	......	... ..	3–30
5	.... .	......	......	......	....
6	......	......	......	......	....
7	......	–30	1–45	1–00	3–15
8	1–00	2–30	3–00	......	6–30
9	......	......	......	......	....
10	......	1–15	1–45	–15	3–15
11	1–30	–45	......	......	2–15
12	......	......	......	......	....
13	......	–15	......	......	–15
14	......	1–45	–15	......	2–00
15	......	......	......	......	....
16	......	.....	–30	......	–30
17	......	......	–30	......	–30
18	......	1–30	2–45	1–00	5–15
19	......	......	......	......	....
20	......	......	......	......	....
21	......	......	......	......	....
22	......	–45	......	......	–45
23	......	......	......	......	....
24	......	......	......	......	....
25	......	......	–45	–45	1–30
26	......	......	......	......	....
27	1–30	1–30	1–45	–15	5–00
28	......	......	......	......	....
29	......	......	......	1–30	1–30
30	......	......	2–15	1–00	3–15
31	......	......	......	......	....
Total	5–30	15–45	17–00	5–45	44–00
Per cent of possible sunshine	9–4	16–9	18–3	9–8	1–45
Feb. 1	......	......	......	......	....
2	......	......	......	......	....
3	......	......	......	......	....
4	......	......	......	......	....
5	......	......	......	–15	–15
6	......	......	......	.....	....
7	......	......	......	......	....
8	......	......	......	–15	–15
9	–15	2–30	2–45	2–00	7–30
10	1–30	2–30	–30	......	4–30
11	......	......	......	......	....
12	......	1–00	......	......	1–00
13	1–00	3–00	3–00	2–15	9–15
14	2–00	2–45	3–00	1–30	9–15
15	......	......	......	......	....
16	......	......	......	......	....
17	–45	–45	1–15	1–00	3–45
18	......	......	1–30	......	1–30
19	......	......	......	......	....
20	......	......	......	......	....
21	......	......	......	......	....
22	......	......	–30	......	–30
23	1–15	2–00	......	......	3–15

SUNSHINE, 1887 — (*Continued*).

	Before 9 A. M.	9-12	12-3.	After 3 P. M.	Total.
	h. m.	h. m.	h. m.	h. m.	h. m.
Feb. 24	–45	1–30	–45	......	3–00
25	2–00	3–00	3–00	2–30	10–30
26	......	......	......	......	....
27	......	......	......	–15	–15
28	......	2–30	3–00	1–15	6–45
Total	9–30	21–30	19–15	11–15	61–30
Per cent. of possible sunshine	11–2	25–6	22–9	13–3	18–2
March 1	......	......	–45	......	–45
2	2–00	3–00	2–30	–30	8–00
3	2–15	1–00	1–00	......	4–15
4	–15	2–45	3–00	2–30	8–30
5	......	......	......	......	....
6	......	......	......	......	....
7	......	......	......	......	....
8	2–30	3–00	3–00	2–45	11–15
9	2–30	2–15	1–30	......	6–15
10	......	......	......	–15	–15
11	1–30	2–30	3–00	2–00	9–00
12	2–15	3–00	3–00	2–00	10–15
13	2–15	–30	......	......	2–45
14	......	......	......	......	....
15	......	......	......	......	....
16	–30	......	......	......	–30
17	......	......	......	......	....
18	......	......	......	......	....
19	......	......	......	......	....
20	......	–15	–15	......	–30
21	......	–30	......	......	–30
22	......	......	......	......	....
23	1–00	3–00	3–00	1–45	8–45
24	–15	2–30	1–45	......	4–30
25	......	1–45	1–30	1–15	4–30
26	–45	2–00	2–30	–45	6–00
27	......	......	–15	......	–15
28	......	......	–15	......	–15
29	......	1–45	–45	......	2–30
30	2–15	3–00	3–00	1–45	10–00
31	2–45	3–00	3–00	2–30	11–15
Total	23–00	35–45	34–00	18–00	110–45
Per cent of possible sunshine	24–6	38–4	36–6	19–2	29–7
April 1	1–30	3–00	3–00	1–30	9.00
2	2–30	3–00	3–00	2–15	10–45
3	2–00	3–00	2–00	1–15	8–15
4	......	......	......	......	....
5	–45	–45	–10	–05	1–45
6	2–15	3–00	3–00	2–45	11–00
7	2–15	3–00	3–00	3–00	11–15
8	2–15	3–00	3–00	2–15	10–30
9	1–30	3–00	3–00	1–45	9–15
10	1–15	3–00	3–00	2–15	9–30
11	......	......	–30	–15	–45
12	......	......	......	......	....

Sunshine, 1887 — *(Continued).*

	Before 9 A. M.	9-12.	12-3.	After 3 P. M.	Total.
	h. m.	h. m.	h. m.	h. m.	h. m.
April 13	......	......	2-00	-45	2-45
14	......	......	1-00	-30	1-30
15	......	......	-30	1-15	1-45
16	......	......	......	......	....
17	1-00	3-00	2-00	-15	6-15
18	......	......	......	......	....
19	2-00	3-00	3-00	2-00	10-00
20	2-45	3-00	1-30	......	7-15
21	1-30	1-30	......	1-15	4-15
22	1-00	2-30	3-00	2-45	9-15
23	......	......	......	......	....
24	2-45	2-30	-30	......	5-45
25	2-45	2-30	......	......	5-15
26	3-00	2-00	......	......	5-00
27	2-15	2-30	-15	......	5-00
28	2-45	1-00	......	......	3-45
29	......	......	......	......	....
30	......	2-30	3-00	3-45	9-15
Total	38-00	50-45	40-30	29-45	159-00
Per cent of possible sunshine	34-5	56-2	45-00	27-00	39-9
May 1	2-45	1-30	-30	-30	5-15
2	-15	2-00	1-30	-15	4-00
3	1-00	2-00	3-00	3-30	9-35
4	1-30	3-00	3-00	3-15	10-40
5	2-00	1-30	2-15	2-15	8-00
6	1-45	2-00	1-00	-15	5-00
7	-30	1-15	3-00	-15	5-00
8	3-15	3-00	1-00	1-30	8-45
9	2-45	3-00	1-45	-30	8-00
10	-15	-15	......	3-45	4-15
11	3-30	3-00	3-00	3-30	13-00
12	2-15	3-00	1-00	2-15	8-30
13	3-30	3-00	3-00	3-30	13-00
14	3-30	3-00	3-00	3-30	13-00
15	3-30	3-00	3-00	3-30	13-00
16	3-30	3-00	3-00	2-45	12-15
17	2-45	1-45	3-00	3-00	8-00
18	1-30	3-00	2-00	2-30	9-00
19	3-15	3-00	3-00	1-30	10-45
20	3-00	3-00	3-00	3-00	12-00
21	3-15	3-00	3-00	3-30	12-45
22	3-00	3-00	3-00	......	9-00
23	1-30	2-30	1-30	-30	6-00
24	-30	2-30	1-45	......	4-45
25	2-30	3-00	2-00	-45	8-15
26	2-45	1-00	-30	......	4-15
27	......	......	......	1-00	1-00
28	......	......	......	......	....
29	2-45	3-00	3-00	3-45	12-30
30	4-00	3-00	3-00	3-15	13-15
31	3-30	3-00	3-00	2-45	12-15
Total	70-00	72-15	64-45	58-00	265-00
Per cent of possible sunshine	52-5	77-7	69-6	43-4	58-4

SUNSHINE, 1887 — (*Continued*).

	Before 9 A. M.	9-12.	12-3.	After 3 P. M.	Total.
	h. m.	h. m.	h. m.	h. m.	h. m.
June 1	......	......	......	4–00	4–00
2	-30	-15	......	......	–45
3	1-45	3-00	3–00	4–00	11–45
4	......	......	......	......	....
5	......	......	......	......	....
6	......	......	......	......	....
7	-45	-30	......	–15	1–30
8	......	1-00	2–15	3–45	7–00
9	......	......	–45	2–00	2–45
10	2-30	3-00	2–45	4–00	12–15
11	3-45	3-00	3–00	3–45	12–30
12	4-00	3-00	3–00	2–45	12–45
13	3-45	2-45	1–00	2–30	10–00
14	4-00	3-00	3–00	4–00	14–00
15	4-00	3-00	3–00	3–45	13–45
16	3-00	1-30	1–30	3–15	9–15
17	-30	1-15	–15	......	2–00
18	......	......	......	......	....
19	......	......	1–30	......	1–30
20	......	3-00	3–15	3–15	9–15
21	1-00	1-15	–30	1–15	4–00
22	......	-15	–30	–45	1–30
23	4-00	2-30	2–00	2–00	10–30
24	......	1-15	–15	–30	2–00
25	4-00	2-30	2–00	1–00	9–30
26	3-45	3-00	3–00	3–45	13–30
27	3-30	3-00	2–30	2–30	11–30
28	3-45	3-00	3–00	4–00	13–45
29	3-45	3-00	3–00	3–45	13–30
30	3-45	3-00	3–00	2–15	12–00
Total	56-00	51-00	47–45	63–00	217–45
Per cent of possible sunshine	40-4	56-6	53–0	45–5	47–6
July 1	2-45	2-30	2–45	3–00	11–00
2	3-30	3-00	3–00	3–00	12–30
3	3-30	3-00	1–30	2–15	10–15
4	2-45	3-00	2–15	3–15	11–15
5	2-00	1-15	–15	1–15	4–45
6	2-00	2-15	–45	3–00	8–00
7	3-45	3-00	3–00	3–00	12–45
8	3-30	3-00	3–00	3–30	13–00
9	1-30	2-45	......	......	4–15
10	1-15	1-00	......	......	2–15
11	3-30	3-00	3–00	3–30	13–00
12	3-30	3-00	3–00	3–30	13–00
13	1-30	3-00	3–00	3–45	11–15
14	3-30	3-00	3–00	2–00	11–30
15	-30	......	......	1–00	1–30
16	2-45	3-00	2–30	2–00	10–15
17	......	......	2–00	2–00	4–00
18	......	......	......	1–15	1–15
19	2-00	3-00	2–30	3–30	11–00
20	3-00	3-00	3–00	2–00	11–00
21	......	1-45	1–30	......	3–15
22	2-00	1-00	1–30	......	4–30
23	-15	2-45	3–00	3–00	9–00
24	2-30	2-00	3–00	3–00	10–30

SUNSHINE, 1887 — *(Continued).*

	Before 9 A. M.	9–12.	12–3.	After 3 P. M.	Total.
	h. m.	h. m.	h. m.	h. m.	h. m.
July 25	-30	......	......	......	-30
26	......	1-30	3-00	3-30	8-00
27	3-15	3-00	3-00	3-15	12-30
28	3-00	3-00	3-00	2-15	11-15
29	......	1-15	2-45	3-00	7-00
30	2-30	3-00	3-00	3-00	11-30
31	2-30	3-00	3-00	3-15	11-45
Total	63-15	68-00	65-51	71-00	267-30
Per cent of possible sunshine	4-59	73-1	70.1	51-4	57-9
Aug. 1	3-00	2-45	2-30	2-30	10-45
2	2-30	2-45	3-00	3-00	11-15
3	2-30	3-00	3-00	3-00	11-35
4	......	2-15	1-00	3-00	6-10
5	......	......	-45	2-00	2-45
6	......	2-30	3-00	3-00	8-30
7	3-00	3-00	3-00	3-45	12-45
8	3-15	3-00	3-00	3-15	12-30
9	3-00	3-00	3-00	3-00	12-00
10	......	......	.....	......	....
11	......	......	......	1-15	1-15
12	2-00	3-00	3-00	3-00	11-00
13	2-15	3-00	3-00	3-30	11-45
14	3-00	2-45	2-45	1-00	9-30
15	-15	3-00	-30	-30	4-15
16	1-45	1-30	......	3-00	6-15
17	2-00	2-00	-30	......	4-30
18	-45	1-30	2-30	1-30	6-15
19	-45	1-30	2-30	1-30	6-15
20	2-00	3-00	3-00	2-45	10-45
21	......	3-00	......	......	3-00
22	......	......	......	......	......
23	-15	......	1-15	3-00	4-30
24	-15	-30	-15	......	1-00
25	2-45	1-45	3-45	3-15	10-30
26	3-00	2-45	-30	3-00	9-15
27	2-45	2-00	-15	1-15	6-15
28	2-45	1-15	2-00	3-00	9-00
29	2-45	3-00	3-00	2-00	10-45
30	2-30	3-00	1-15	3-00	9-45
31	2-45	3-00	3-00	3-00	11-45
Total	51-45	63-45	54-15	66-00	235-45
Per cent of possible sunshine	42-6	68-5	58-3	54-3	55-0
Sept. 1	3-00	2-30	......	......	5-30
2	......	......	......	......	....
3	1-45	2-30	3-00	3-00	10-15
4	3-00	3-00	3-00	3-00	12-00
5	3-00	3-00	-45	2-00	8-45
6	......	......	......	......	....
7	1-00	1-00	1-30	......	3-30
8	-30	2-00	-15	-45	3-30
Total	12-15	14-00	8-30	8-45	43-30
Per cent of possible sunshine	45-0	58-3	36-2	31-5	42-0

Monthly Summary of Sunshine from May 1, 1885, *to September* 1, 1887.

	1885.		1886.		1887.	
	Hours.	Per cent.	Hours.	Per cent.	Hours.	Per cent.
January	......	....	43.25	14.3	44.00	14.5
February	......	....	80.00	26.7	61.50	18.2
March	......	....	83.25	22.3	110.75	29.7
April	......	....	144.75	36.3	159.00	39.9
May	165.00	36.4	235.75	51.9	265.00	58.4
June	237.5	52.0	252.25	54.2	217.75	47.6
July	281.75	53.8	243.25	52.6	267.5	57.9
August	353.5	38.1	240.25	56.0	235.75	55.0
September	206.75	55.3	200.3	53.7	......	.....
October	134.5	39.3	142.75	41.8	......	.....
November	53.00	18.1	102.00	34.8	......	.....
December	50.00	17.6	68.5	24.2	......	.....

REPORT OF THE ASSISTANT CHEMIST.*

The principal topics considered in this report are summarized below in the order in which they are presented:

1. Variation in the composition of grasses for two successive years.
2. Early and late cut timothy.
3. Hay from different localities.
4. Forage plants.
5. Analyses of fodders.
6. Wheat and its products.
7. Amount of water in farm products.
8. New vs. old hay and grain.
9. Influence of fertilizers upon the composition of timothy and clover.
10. Amount of nitrogen, phosphoric acid and potash removed from the soil by different crops.
11. Average composition of feeding stuffs examined at this station.
12. Methods of analysis.
13. Some edible fungi.
14. Ice cream poisoning.

Since there seems to be some confusion and misunderstanding of the terms used in the expression of fodder analyses, a few words of explanation may be appropriate at this point before entering upon a consideration of the fodders themselves.

Water.—The loss in weight of a fodder by drying, usually at 100 to 110 C., is due to the moisture or water which the fodder contains.

Ash.—That part of the fodder which remains unconsumed by burning, constitutes the ash or mineral matter. The ash ingredients form the solid matter of the animal frame-work — bones — and occur also in small quantities in the muscles, blood, etc.

Albuminoids.—The albuminoids are the principal nitrogenous portion of fodders — the muscle-formers — sometimes also called protein. The albuminoids are not a definite compound, but are made up of a large number of nitrogenous products which have usually been classed alike for feeding purposes. The white of an egg, the tenacious mass —

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*E. F. Ladd.

gluten — which remains on washing the dough from wheat flour and animal muscle are common examples of this class of products.

Not all of the nitrogenous matter of feeding stuffs is in the form of albuminoids, but often a considerable portion is in what may be termed a transitory state known by the general name amides. Amides are supposed to have a less nutritive value than the true albuminoids. However, they probably have a greater nutritive value than many experimenters have assigned to them.

Crude fiber is the woody portion of vegetable matter which is unacted upon by dilute acids or alkalies. Crude fiber has little or no direct nutritive value to the animal.

Nitrogen-free extract, sometimes called carbohydrates, is a mixture of various substances. The starches, sugars, dextrine, pectic and mucilaginous bodies, gums, etc., are the principal constituents.

Fat.—The ether extract of feeding stuffs, taken as fat or vegetable oils, is a mixture of oils, wax, coloring matter, etc. Cotton seed oil, linseed oil, corn oil, etc., are common examples.

VARIATION IN THE COMPOSITION OF GRASSES FOR TWO YEARS.

In my report for 1886* I noted the variation in the chemical composition of grasses for different cuttings of the same season, showing that the proportion of albuminoids to the other organic constituents of the plant was much larger in the second and subsequent cuttings than in the first. Another year gives us an opportunity to determine what variation there may be in the chemical composition of grasses for different years when grown under like conditions, so far as soil and locality are concerned. With the exception of the timothy, the grasses were all from the Station grass plats for both years and were collected at about the same stage of growth, that is, full bloom. The timothy was taken both years from the same place, in a large field. It may be well to state here that early in the spring of 1886 all of the grass plats received a top-dressing of acid phosphate, but none was applied to the field of timothy. The following table gives the chemical composition of the grasses for both years:

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*New York Agricultural Experiment Station, 1886, p. 374.

GRASSES.	Fresh Substance.						Dry Substance.				
	Water.	Ash.	Albuminoids. Nx6.25.	Crude fiber.	Nitrogen free extract.	Fat (ether extract).	Ash.	Albuminoids. Nx6.26.	Crude fiber.	Nitrogen free extract.	Fat (ether extract).
Orchard grass, '86	65.00	1.99	2.58	12.54	16.73	1.16	5.70	7.38	35.84	47.77	3.31
Orchard grass, '87	73.19	1.84	2.40	10.56	10.87	1.14	6.86	8.94	39.39	40.56	4.25
Fort Bellingham, '86	61.78	2.41	2.98	13.75	17.79	1.29	6.30	7.81	35.99	46.53	3.37
Fort Bellingham, '87	63.38	2.30	3.68	12.23	17.12	1.29	6.27	10.06	33.39	46.75	3.53
Meadow Fescue, '86	68.70	1.97	2.44	10.93	14.82	1.14	6.29	7.81	34.93	47.34	3.63
Meadow Fescue, '87	66.52	2.96	3.73	11.14	14.34	1.31	8.84	11.13	33.28	42.83	3.92
Reed Canary, '86	65.23	2.47	3.65	10.33	16.98	1.34	7.10	10.50	29.72	48.83	3.85
Reed Canary, '87	66.52	1.81	3.60	10.65	16.17	1.25	5.42	10.75	31.81	48.29	3.73
Tall Meadow Oat, '86	69.07	1.63	2.09	10.76	15.46	1.01	5.26	6.75	34.78	49.94	3.27
Tall Meadow Oat, '87	69.86	1.83	3.12	10.50	13.30	1.39	6.06	10.37	34.83	44.12	4.62
Timothy, '86	71.36	1.36	1.34	8.56	16.54	.84	4.75	4.69	29.88	57.75	2.93
Timothy, '87	59.85	2.22	3.26	12.30	21.14	1.23	5.54	8.12	30.65	52.62	3.07

The great variation shown in the dry substance, also in the water content, for the two years, leads us to carry further our investigation, to learn whether any other differences could be found.

ALBUMINOID AND NON-ALBUMINOID NITROGEN.

NAME OF GRASS.	Date cut.	Total nitrogen.	Albuminoid nitrogen.	Amide nitrogen.	Per cent of total nitrogen in amide form.
Orchard grass, '86	June 9	1.18	.44	.74	62.71
Orchard grass, '87	June 7	1.43	1.13	.30	20.98
Fort Bellingham, '86	June 15	1.25	.87	.38	30.40
Fort Bellingham, '87	June 14	1.61	1.17	.44	27.33
Meadow Fescue, '86	June 11	1.25	1.08	.17	13.60
Meadow Fescue, '87	June 14	1.78	1.28	.50	28.09
Reed Canary, '86	June 19	1.68	1.30	.38	22.61
Reed Canary, '87	June 14	1.72	1.44	.28	12.28
Tall Meadow Oat, '86	June 9	1.08	.92	.16	14.81
Tall Meadow Oat, '87	June 7	1.66	1.30	.36	21.67
Timothy, '86	June 28	.75	.38	.37	49.33
Timothy, '87	June 29	1.30	.92	.38	29.23

Unfortunately, the sugars and starch were not determined in the grasses for 1886; so we are unable to compare the differences in the nitrogen free extract for the two years.

DIGESTIBILITY.

The following table gives the amount of total or crude albuminoids, the true albuminoids and the per cent of each, digested by pepsin digestion:

GRASS.	Per cent of crude albuminoids.	Per cent of true albuminoids.	Per cent undigested.	Per cent of crude albuminoids digested	Per cent of true albuminoids digested.
Orchard grass, 1886	7.38	2.75	2.44	66.93	11.28
Orchard grass, 1887	8.94	8.12	3.69	58.72	54.55
Fort Bellingham, 1886	7.81	5.44	1.81	76.82	66.72
Fort Bellingham, 1887	10.06	7.31	3.12	67.99	57.31
Meadow Fescue, 1886	7.81	6.75	2.73	65.04	59.55
Meadow Fescue, 1887	11.13	8.00	3.37	69.72	57.87
Reed Canary, 1886	10.50	8.13	2.75	73.81	66.17
Reed Canary, 1887	10.75	9.00	3.81	64.56	57.66
Tall Meadow Oat, 1886	6.75	5.75	1.88	72.15	67.30
Tall Meadow Oat, 1887	10.37	8.12	2.94	71.63	63.79
Timothy, 1886	4.69	2.38	2.06	56.08	13.44
Timothy, 1887	8.12	5.75	3.25	59.97	43.47

ASH ANALYSES.

Partial ash analyses were made for a few of the grasses, for both years, and the results are given in the following table:

	Ash.	P_2O_5	K_2O	Na_2O	CaO	MgO
Orchard grass, '86	5.69	7.96	32.26	.84	8.66	1.62
Orchard grass, '87	6.95	7.40	42.72	.47	7.20	2.11
Meadow Fescue, '86	6.17	6.90	23.66	1.26	......	......
Meadow Fescue, '87	6.06	7.03	31.56	5.28	11.84	3.35
Tall Meadow Oat, '86	5.03	6.67	39.92	4.37	7.40	tr.
Tall Meadow Oat, '87	5.94	7.16	34.60	7.04	7.76	3.07
Timothy, '86	4.06	4.41	27.02	1.62	......	......
Timothy, '87	5.54	6.95	30.72	5.28	10.00	2.24

In order to compare these analyses to learn the real differences, it is necessary to calculate the ash analysis on the dry substance, and the following table gives the data:

ASH CONSTITUENTS IN THE HAY.

	P_2O_5	K_2O	Na_2O	CaO	MgO	Nitrogen.
Orchard grass, '86........	.454	1.835	.048	.493	.092	1.18
Orchard grass, '87........	.514	2.699	.032	.500	.147	1.43
Meadow Fescue, '86......	.426	1.460	.078	......	......	1.25
Meadow Fescue, '87......	.426	1.912	.320	.717	.203	1.78
Tall Meadow Oat, '86....	.335	2.008	.230	.372	tr.	1.08
Tall Meadow Oat, '87	.428	2.055	.418	.461	.182	1.66
Timothy, '86	.179	1.097	.066	......	......	.75
Timothy, '87	.385	1.702	.292	.554	.123	1.30

An inspection of the table of analyses for the dry substance shows the hays for this season to be considerably richer in albuminoids than were the hays from the same plats last year, while the nitrogen free extract is proportionally lower. The next point of importance is to know how the yield per acre compares for the two years. Unfortunately, no account was taken of this, but my colleague, Mr. Plumb, has furnished me with some figures for the yield of hay upon the Station plats which will serve as an indication of how the yield compares for the two years. The grass on 100 square feet of the same plats from which my samples were taken was cut and the hay weighed for each year, and was as follows:

	Pounds.
Orchard grass, 1886	22
Orchard grass, 1887	12¾
Tall Meadow Oat, 1886	15
Tall Meadow Oat, 1887	12
Meadow Fescue, 1886	12¼
Meadow Fescue, 1887	7

We do not know whether the proportion of water in the hay for the two years was the same or not, but taken as the figures stand we find that the yield of hay from the same plats was about 39 per cent less for 1887 than for 1886, and the table of analyses shows that in these same hays there was an increase in albuminoids of about 38 per cent. It seems, then, that the increase in nutritive value for the hays this year over last year has been at the expense of a smaller crop, and if, as seems true from the data we have, the real difference between the feeding value of a maximum and a minimum crop may not always be so great as would be indicated by the yield of hay per acre. We have found, in these experiments at least, that the minimum crop of 1887 had a considerably higher nutritive value from its greater richness in albuminoids than did the larger crop of 1886.

An examination of the table of the digestibilities shows that the digestion coëfficients are lower with the hays of this year than for those of last, which at first seems to be contradictory to the general opinion that the more highly nitrogenous the hay is the higher the digestion coëfficient, but still, in general this rule may be true, for other influences not generally recognized in this connection seem to enter in to modify the results. When we compare the grasses of this season we find those containing the largest proportion of albuminoids to be the most digestible, and an inspection of the table in my report for last year shows the same relation to hold for the grasses of that season, although when we compare the grasses of this year with that grown upon the same plats last year, which were poorer in albuminoids, we find them showing the opposite. This variation between different years may be due largely to meteorological and other influences which can only be determined after a number of years' careful observations. Believing that a comparison of the meteorological records for a series of years in connection with the analysis of the plants, will aid in answering some of these questions, I have tabulated from the Station meteorological records, in periods of ten days, from April 1 to the end of June, the sunshine, air temperature, soil temperature at three and nine inches depths and the rainfall. I have preferred to use the noon temperature for both soil and air, but further study may show it to be necessary to change this to more complete records. The following table gives the total or averages for periods of ten days:

	April 1-10.	April 11-20.	April 21-30.	May 1-10.	May 11-20.	May 21-31.	June 1-10.	June 11-20.	June 21-30.	Averages or totals
Hours of bright sunshine, 1886.	37	65	43	66	77	92	101	85	67	633
Hours of bright sunshine, 1887	81	30	48	69	113	84	40	86	91	642
Noon temp., 1886	39.6	60.1	61.2	60.7	62.5	67.1	71.5	72.6	71.3	63.1
Noon temp., 1887	48.0	41.6	52.5	70.4	70.4	71.6	68.1	77.9	75.1	63.9
Noon soil temp., 3 in., 1886......	42.1	57.0	61.0	61.8	61.3	65.8	71.6	74.8	71.1	62.3
Noon soil temp., 3 in., 1887......	....	45.6	50.9	65.5	69.1	71.5	69.8	76.9	76.6	65.7
Noon soil temp., 9 in., 1886......	38.2	49.2	54.4	56.4	55.6	56.9	62.9	68.7	65.2	56.3
Noon soil temp., 9 in., 1887......	....	42.1	44.6	55.8	59.7	62.6	63.4	66.7	65.6	57.5
Rainfall, inches, 1886	3.05	.27	.81	.66	.91	.35	.44	.39	2.09	8.97
Rainfall, inches, 1887	0	.34	1.03	.04	0	.42	.76	.64	.61	3.84

We find that the temperature of both the air and soil was considerably lower during April of the present year than for April of 1886, while for the season just passed the rainfall for May was almost nothing until the very last days of the month. These two influences may have largely determined the growth, that is, the formation and number of stalks, while the higher temperature and more sunshine during the period of most rapid growth may have, by increasing the evaporation through the plant, produced the large albuminoid content of the grasses. When another year's records shall have been added to those already given it is hoped that we may be able to trace more fully the relation between plant growth and the variation in temperature, sunlight and rainfall.

EARLY AND LATE CUT TIMOTHY.*

1. *Analysis of the Hays.*
2. *Sugars and Starch.*
3. *Albuminoid and Non-Albuminoid Nitrogen.*

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* The data and conclusions given under this topic are essentially those given in the article "Some Changes in Timothy as it Approaches Maturity," published in Agricultural Science, Vol. 1, No. 10.

4. *Digestibility.*
5. *Ash Analysis.*
6. *Conclusions.*

Several experiments have already been made, and published by others, to determine the relative value of early and late cut hay for feeding, but most of these experiments have been conducted without a chemical examination of the hays and without determining their digestibility, but rather as to the quantity of hay harvested at different periods, or to their value as found by feeding experiments of short duration.

The present investigation was undertaken, wholly from a chemical standpoint, to find whether any differences could be detected in the chemical composition and digestibility of three samples of timothy cut June 29, while in full bloom, and three other samples from the same plats, July 14, after the seeds had formed, but before they were matured.

ANALYSIS.

Plat.	TIMOTHY.	FRESH SUBSTANCE.						DRY SUBSTANCE,				
		Water.	Ash.	Albuminoids, Nx 6.25	Crude fiber.	Nitrogen free extract.	Fat ether extract.	Ash.	Albuminoids, Nx 6.25.	Crude fiber.	Nitrogen free extract,	Fat (ether extract).
VI ...	Full bloom	57.32	1.85	3.41	13.92	22.39	1.11	4.33	8.00	32.61	52.46	2.60
VI ...	Late cut....................	46.98	1.91	3.38	18.56	27.74	1.43	3.61	6.37	35.01	52.32	2.69
XV ...	Full bloom	59.85	2.22	3.26	12.30	21.14	1.23	5.54	8.12	30.65	52.62	3.07
XV ...	Late cut	48.68	2.31	3.31	19.35	25.03	1.32	4.51	6.44	37.71	48.77	2.57
XIX ...	Full bloom	59.77	2.23	3.14	12.74	20.84	1.28	5.54	7.81	31.67	51.80	3.18
XIX ...	Late cut	48.78	2.48	3.14	16.57	27.43	1.60	4.84	6.13	32.37	53.53	3.13

An examination of the above table shows a marked diminution in the per cent of ash and albuminoids of the dry substance for the late cut hay and a considerable increase in fiber, while the proportion of nitrogen free extract remains practically unchanged.

In the fresh substance there has been a large loss of water, but this diminution in water tended to equalize the albuminoids so that the per cent present is very nearly the same for the fresh substance in both the early and late cut timothy.

SUGARS AND STARCH.

The slight differences in the amount of nitrogen free extract of the dry substance and for the early and late cut hay leads us to further examine them and to determine the amount of sugar and starch to see whether there exists any real difference in the composition of the nitrogen free extract.

Plat.	TIMOTHY.	Invert sugar, etc.	Sucrose, etc.	Starch.	Per centof nitrogen free extract as sugars and starch.
VI. ..	Full bloom	3.60	6.36	22.61	62.08
VI. ..	Late cut	2.60	4.00	22.38	55.39
XV. ..	Full bloom	3.72	5.96	18.07	52.73
XV. ..	Late cut	2.32	5.40	21.66	60.24
XIX. ..	Full bloom	3.04	4.68	19.45	52.46
XIX. ..	Late cut	2.00	5.20	22.61	55.69

In the hays from plat VI, we find the more mature hay suffered a loss in per cent of both sugars and starch, while in plats XV and XIX there was a gain of starch. Of invert sugar there was a diminution in per cent in each case for the more mature hay.

ALBUMINOID AND NON-ALBUMINOID NITROGEN.

A determination of the true albuminoid nitrogen and amide nitrogen in the early and late cut timothy gave us the following results:

Plat.	TIMOTHY.	Total nitrogen.	Albuminoid nitrogen.	Amide nitrogen.	Per cent of total nitrogen in amide form.
VI. ..	Full bloom	1.28	1.20	.08	6.40
VI. ..	Late cut	1.02	.84	.18	17.64
XV. ..	Full bloom	1.30	.92	.38	29.23
XV. ..	Late cut	1.03	.68	.35	33.98
XIX. ..	Full bloom	1.25	1.20	.05	4.00
XIX. ..	Late cut	.98	.98	.00	.00

From an examination of the preceding table we find that the total nitrogen averages 20.56 per cent less in the late cut timothy than in that cut in full bloom. Instead of the proportion of albuminoid nitrogen to the total nitrogen increasing between the period of full bloom and seed formation, there was rather a considerable diminution, with a corresponding increase in the relative proportion of amide nitrogen. The increase in amide nitrogen was probably due to the breaking up and transferring of the albuminoids of the stalk to the seeds, which were formed but not fully developed when the second cutting was made. That is, the nitrogen taken up by the grass at this period of its growth seems to have been very small, while the transfer of material from the stem to the seed was rapidly going forward, and the formation of starch and fiber was progressing throughout the plant, so that the increase of organic matter was considerable.

DIGESTIBILITY.

Having determined the principal proximate constituents of the hays, we may, by determining the digestibility of their albuminoids, be able to throw further light upon the relative value of early and late cut hay for feeding;

Plat.	TIMOTHY.	Total albuminoids, Nx. 6.25.	True albuminoids.	Per cent undigested.	Per cent of total albuminoids digested.	Per cent of true albuminoids digested.
VI ...	Full bloom...............	8.00	7.50	3.87	51.62	48.40
VI ...	Late cut..................	6.37	5.25	3.56	44.11	32.19
XV ...	Full bloom...............	8.12	5.75	3.25	59.97	43.47
XV ...	Late cut..................	6.44	4.25	......	......	....
XIX ...	Full bloom...............	7.81	7.50	3.75	50.70	50.00
XIX ...	Late cut..................	6.13	6.13	3.87	36.83	36.83

From the above table we find that there was a marked decrease in digestibility of the albuminoids for the late cut timothy over that cut in full bloom, and the figures are further suggestive as pointing out a possible explanation for the great variation in the digestion coëfficients found by different investigators, or the same investigators in different years, for similar hays. If, as seems to be the case from the trials we have made, the more mature hay is less digestible than that cut earlier, then two feeding trials made with similar hays, but at different stages of maturity, might show a difference in their coëfficients of digestibility of at least 23 per cent as indicated by the last table, which, aside from any idiosyncrasies of the animal, might be sufficient to reconcile the results.

ASH ANALYSIS.

A partial analysis of the ash of the grasses was made, with results as shown in the following table:

Plat.	TIMOTHY.	Ash.	Phosphoric acid. P_2O_5	Potash. K_2O	Soda. Na_2O	Lime. CaO	Magnesia. MgO
VI. ..	Full bloom....	4.41	4.96	32.88	4.48	8.64	2.53
VI. ..	Late cut.......	3.60	4.50	28.87	6.68	13.20	2.01
XV. ..	Full bloom....	5.54	6.95	30.72	5.28	10.00	2.24
XV. ..	Late cut.......	4.51	7.24	26.68	11.20	11.20	1.65
XIX. ..	Full bloom....	5.54	6.14	29.96	......	7.76	2.04
XIX. ..	Late cut.......	4.84	6.03	29.44	6.82	7.68	2.16

In the late cut hay the per cent of ash was considerably diminished and the composition of the ash had changed. There was a marked increase in soda and of lime in VI and XV, and a corresponding falling back in per cent of potash and magnesia except in the last, while in phosphoric acid there was a gain in per cent in one instance and a loss in the other two. The figures may be more suggestive by calculating the per cent of ash constituents in the hay itself, dry substance, as given in the following table:

Plat.	TIMOTHY.	Phosphoric acid. P_2O_5	Potash. K_2O	Soda. Na_2O	Lime. CaO	Magnesia. MgO	Nitrogen
VI. ..	Full bloom....	.219	1.450	.197	.381	.111	1.28
VI. ..	Late cut.......	.172	1.039	.240	.475	.072	1.02
XV. ..	Full bloom....	.385	1.702	.293	.554	.124	1.30
XV. ..	Late cut.......	.326	1.203	.505	.505	.074	1.03
XIX. ..	Full bloom....	.340	1.659	......	.430	.119	1.25
XIX. ..	Late cut.......	.292	1.425	.330	.372	.104	.98

Calculated in the hay, dry substance, we find the relation between our figures do not hold, in all cases, the same as in the ash. In the hay we find a diminution in the proportion of phosphoric acid, potash, magnesia and nitrogen taken up by the timothy, as it approached maturity, and a considerable increase in soda, while with the lime we find both gain and loss.

CONCLUSIONS.

Having now examined the early and late cut timothy so fully as our time will admit for the present, we may briefly summarize from the tables already given such conclusions as seem permissible from our data.

1. The amount of water in the timothy diminished rapidly after the period of full bloom.

2. There was a large increase in the amount of crude fiber in late cut timothy, over that cut at period of full bloom.

3. As the grass approached maturity there was a considerable diminution in the per cent of sugars, and an increase in starch.

4. The proportion of albuminoids to the other organic constituents diminished after the period of full bloom.

5. The albuminoids of timothy were much less digestible in the late cut hay than in that at full bloom.

6. Between the period of full bloom and seed formation there seems to have been a reduction of some of the albuminoids to the amide form, probably in the course of the albuminoids being transferred from the stem to the seed, or in some way connected with the formation or translocation of the sugars and starch.

7. From our experiments it seems that the increase in the quantity of timothy, after the period of full bloom, was not sufficient to overbalance the lower digestibility of the albuminoids, together with the large increase in fiber.

8. Finally, from a chemical point of view, it seems preferable to cut timothy, for feeding, at the period of full bloom, rather than after the seeds have formed.

HAYS FROM DIFFERENT LOCALITIES.

For the purpose of determining the average chemical composition of hay, or of any agricultural product, it is necessary that samples be secured from different localities, in order that we may determine the climatic and other influences which affect the composition and productiveness of the crop. Such samples should be had for a number of years, that we may know what yearly changes are to be expected for each locality. It is shown from the analyses under the head of "Variation in the chemical composition of grasses for two years," that we may expect as great difference between the same kind of grass grown on the same plat for two successive years as between that from widely separated localities, so that the hay from any locality must be examined for a series of years before we can determine the average composition for that locality, and from these averages must be gathered the average for the product.

As a beginning to the study upon the composition of the grasses, a few samples of timothy have been secured, during the past year from Wisconsin and from Maine, for which I am indebted to Dr. H. P. Armsby, of the Agricultural Experiment Station at the University of

Wisconsin, and to Prof. W. H. Jordan, of the Maine Agricultural Experiment Station. These samples, with those from this Station, show marked differences, which can only be fully accounted for after trials extending through a number of years.

The following description accompanied the sample received from Maine:

No. XV. Crop of 1885, sampled from mow of pure timothy hay.

No. XXIII. Timothy from crop of 1886, cut when about ten days past full bloom, sampled from large lot. This and XV were grown on rather heavy clay loam.

We do not know the history of the sample from Wisconsin, except that it was cut while in bloom.

Those from this Station were grown upon clay soil which had been laid down to grass for several years. The samples for both years were cut from the same plat and at the same stage of development, *i. e.*, in full bloom.

TIMOTHY.	Crude ash.	Albuminoids.	Crude fiber.	Nitrogen, free extract.	Fat, Ether extract.
From Wisconsin, 1886	6.36	8.75	38.85	42.40	3.62
Maine, 1885	5.24	7.56	36.22	48.20	2.78
Maine, 1886	4.01	5.81	35.45	52.01	2.72
Station, 1886	4.75	4.69	29.88	57.75	2.93
Station, 1887	5.54	8.12	30.65	52.62	3.07

The timothy from Maine, crop of 1885, was much richer in albuminoids than the crop of 1886, showing considerable variation in the hays for the two years. In comparing the three timothies of 1886, that from the New York Station is very deficient in albuminoid content, while that from Wisconsin is exceptionally high, but the proportion of fiber is also very high. Certain it is that meteorological influences modify largely the composition of the grasses, for the timothy grown at the Station for two years, 1886 and 1887, under like conditions, so far as soil and treatment were concerned, present such variations as can in no other way be accounted for.

The digestibility of the albuminoids of the several hays was determined, and their coëfficients are given below:

Timothy from	Per cent albuminoids digested.
Wisconsin, 1886	67.39
Maine, 1885	62.53
Maine, 1886	54.80
Station, 1886	56.08
Station, 1887	59.97

The hays having the largest albuminoid contents are also the most digestible, and this places the timothy from Wisconsin first in feeding value. We should expect that feeding experiments made with such hay would give results quite different from those obtained from the use of hay like that grown at this Station in 1886, or that from Maine. The Wisconsin hay has a "feeding ratio," for the dry substance, of 1:9.7, and that from this Station 1:19.3, differences so great that opposite conclusions might be reached by two experimentors using these hays in comparative feeding experiments.

Partial analyses of the ash from each of the several timothies were made, but since the results are tabulated elsewhere they need not be repeated here, for these analyses do not show the real differences that are made manifest when the ash constituents are calculated upon the water-free hays as is given in the next table, together with the per cent of nitrogen.

TIMOTHIES.	Phosphoric acid, P_2O_5.	Potash. K_2O.	Soda. Na_2O.	Nitrogen. N.
From Wisconsin, 1886	0.327	1.593	0.084	1.40
Maine, 1885	0.232	0.834	0.266	1.21
Maine, 1886	0.246	0.728	0.209	0.93
Station, 1886	0.179	1.097	0.066	0.75
Station, 1887	0.385	1.702	0.292	1.30

An inspection of the last table shows even greater differences in the ash constituents of the several hays than were found in the albuminoid content. This is especially true of the potash, for the hay from Maine for 1886 has less than half the amount that either of the other hays contain.

It is hoped that other samples of timothy may be secured and this interesting question of variation traced out until the real differences for locality shall have been determined.

COMPOSITION OF FORAGE PLANTS.

1. CACTUS OR PRICKLY PEAR.
2. PRICKLY COMFREY.

Among the forage plants which have been analyzed during the year, two deserve some notice from the importance which they may be made to assume in stock husbandry in the near future, one among ranchmen at the south, the other in the more closely cultivated regions of the north; the first, the prickly pear, growing extensively in the dry arid regions of the southwest; the other, prickly comfrey, which seems to be especially adapted to the soiling system now being practiced more extensively in the older parts of our country.

CACTUS OR PRICKLY PEAR.

June 2, there was received from D. C. Richardson, New York city, a sample of prickly pear of the genus *Opuntia*, both top and stump, as grown in Texas. Mr. Richardson writes as follows regarding the habits and use of the plant:

> "The prickly pear grows from 3 to 6 feet in height and the plant spreads, covering a ground surface of 5 to 12 feet in diameter. It is considered by the natives to be in best condition for feeding from September to April. After the first of the latter month the sap commences rising. About August the pear-apple comes, which in itself has remarkable properties for fattening, but produces a soft flesh. The sample sent was cut about April 10, that is, the leaf, the piece of root or stump later, and no doubt the sap had commenced to run.
>
> My personal observation leads me to think that the plant is good for feeding any time of year, although the Mexicans say during the time sap is running it is better to cut off the young growing leaves and feed the lower portion, including the stump: in fact some ranchmen hold that the stump contains the most nutriment.
>
> About 5 to 7 lbs. cottonseed meal is fed to about one bushel of the plant cut up in small pieces so as to destroy the thorn. This amount is fed once a day, usually about 4 or 5 o'clock, so the animal will lie down after feeding. With above feed I know of 400 steers each taking on 350 lbs. flesh in 96 days. It is inclined to scour the cattle, although I have known them to live for months on it, there being nothing else for them to eat. Sheep will go three months without water by feeding on it.
>
> The past winter I kept a man employed singeing it over a fire, just burning the thorns off and being careful not to cook it. We saved about 100 head of old cows and calves in this way."

Although having been cut some time, the sample was in good condition, but the water was too much dried out to enable us to even approximate the amount contained in the plant as growing; therefore the analyses are calculated for the dry substance only.

	Top.	Stump.
Ash	22.79	15.78
Albuminoids	6.81	2.94
Crude fiber	14.99	22.54
Nitrogen-free extract	52.92	57.14
Fat (ether extract)	2.49	1.60

Per cent of albuminoids digested: Top, 60.64; stump, 10.88.

A partial examination of the nitrogen-free extract shows the plant to contain

	Top.	Stump.
Invert sugar	0	2.80
Sucrose	5.92	3.60
Starch	9.96	17.10

An examination of the large amount of mucilaginous substance present (particularly in the stump) showed it to be due to pectosic products, but no determination of the amount was made. The high per cent of ash led me to make a partial ash analysis, with results as follows:

	Top.	Stump.
Phosphoric acid, P_2O_5	1.10	0.20
Potash, K_2O	13.88	16.72
Soda, Na_2O	10.56	13.64
Lime, CaO	37.28	35.12
Magnesia, MgO	4.20	4.01

We find it very deficient in phosphates, the bases being combined largely with organic acids or as carbonates.

The deficiency of nitrogenous matter (albuminoids) and the phosphates so essential for growing animals could be supplied readily with cottonseed meal and wheat bran. From the nature of the plant it seems that a machine so constructed as to thoroughly crush the plant would have advantages over one cutting the cactus into small pieces. By mixing the meal with the cactus while crushing, I should expect to secure the best results in feeding.

PRICKLY COMFREY.

June 25 there was received from Dr. Henry Foster, of Clifton Springs, a quantity of prickly comfrey for examination. On a previous visit at Dr. Foster's farm, where five acres of the plant were being grown for soiling, he informed me that he secured five crops each season and that he expected the produce from these five acres would furnish one-half of the fodder, other than grain, for his herd of fifty cows from May until October. He was then feeding two rations per day of corn ensilage and two of comfrey with mixed grains. The field certainly presented a most luxuriant growth of foliage at the time of my visit.

Under date of September 21 Dr. Foster wrote me as follows:

> "We have been using comfrey five years, and we think more of its value this year than any previous year. We are now cutting the fifth crop grown this season. My foreman says that it will average ten tons to the acre for each crop, making fifty tons to the acre for the season. Of course to get such an enormous yield it must be thoroughly cultivated between each cutting and top-dressed. We use for dressing nothing but stable manure, put on immediately after cutting, before cultivating.
>
> We have no forage plant that compares with it in producing quantity and quality of milk."

The sample sent for analysis was just beginning to blossom. The comfrey is under trial at the Station the present season and analyses for both, together with one made three years ago, are given.

No. 1. Sample from Dr. Foster.
No. 2. Sample from Station crop.
No. 3. From report of 1884.

	No. 1.	No. 2.	No. 3.
Fresh Substance.			
Water	88.24	78.70	86.14
Ash	1.64	3.16	2.56
Albuminoids	1.88	3.69	3.25
Crude fiber	2.66	3.19	2.00
Nitrogen-free extract	5.27	10.42	5.68
Fat (ether extract)	.31	.84	.37
Dry Substance.			
Ash	13.93	14.83	18.45
Albuminoids	16.00	17.31	23.44
Crude fiber	22.66	14.98	14.43
Nitrogen-free extract	44.76	48.91	41.02
Fat (ether extract)	2.65	3.97	2.66

An inspection of the above table shows a large percentage of water for the fresh substance, while the water-free substance is much richer in albuminoids than the average feeding stuff. The per cent of ash is very large, which is generally characteristic of rapid-growing succulent plants.

SUGARS AND STARCH.

A determination of the sugars and starch was made in the sample received from Dr. Foster, with results as follows for the dry substance:

	Per cent.
Invert sugar	6.22
Sucrose	0.80
Starch	8.14

The plant contains a large per cent of invert sugar, but rather a small quantity of starch. The plant has very much the gelatinous appearance which characterized the cactus, but as yet we have made no examination of this principle.

ALBUMINOID AND NON-ALBUMINOID NITROGEN.

The albuminoid nitrogen and amides were determined in the same sample, with results as below:

	Per cent.
Total nitrogen	2.56
Albuminoid nitrogen	2.37
Amide nitrogen	.19

The digestibility of the albuminoids we find quite low for sample No. 1, as shown by the following:

	Per cent.
Albuminoids digested	32.06

Time has not permitted a further examination of the samples, but enough is given to show that, from a chemical standpoint, we have in prickly comfrey a promising forage plant for those interested in soiling, and we would recommend its careful trial by the farmers of our State. For further remarks concerning prickly comfrey as a forage plant, the reader is referred to the report of my colleague, Mr. Plumb, who has made, during the present season, some careful experiments with a trial plat.

ANALYSES OF FODDERS.

During the past year an unusually large number of feeding stuffs have been analyzed, and the examinations have been made more complete than has been the case heretofore. The results of the most of these analyses are given and discussed under their appropriate heads, while some of a more or less miscellaneous nature are given in the first tables.

NOTES ON TABLE NO 1.

The analyses of a few feeding stuffs included in these tables have been taken from a former report, and such are marked with an asterisk. These analyses are repeated, as a more complete examination has been made since they were first published, in the way of ash analysis, and in some few a determination of the sugars and starch.

The grasses were all cut at time of full bloom, except the three included in No. 16.

No. 15 is the average of twenty-one analyses, given in full in another part of this report.

No. 16 is the average for three timothies cut after the seeds were formed July fourteen, but before the seed had matured.

No. 17 is the average of twenty-one analyses of clover, from plants differently fertilized, and were from the same source as No. 15.

No. 20 was a sample of ensilaged corn fodder, including the corn, sent on for analysis by W. C. Robinson, Hornellsville, N. Y. The corn was well glazed.

No. 21. A sample from the same source as last, and to all appearances the same.

No. 22. Ensilaged Hungarian grass from same source as last two.

No. 23. A sample of prickly comfrey received from Dr. Henry Foster, of Clifton Springs. For further remarks see "Forage Plants."

No. 24 was a sample of comfrey taken from the first growth from the Station trial plat.

Nos. 25 and 26 are discussed under the head of "Forage Plants."

No. 27. Alsike clover, from Orono, Maine.

Nos. 31–34. In this vicinity it is a common practice among grain growers to stack the straw in the field, so that the water content is larger than for sections where the crop is sheltered from the storms.

Nos. 37 and 38 were from Station-grown crop.

No. 39 was mixed wheats from Messrs. Coursey's flour mill.

No. 40 was a sample of flour from same firm as last.

Nos. 43, 44 and 47 were by-products from same source as No. 40.

No. 50 is the by-product from the manufacturer of corn hominy.

No. 51. This had the appearance of being a kiln-dried waste product from a starch factory. Sent on for examination by Mr. Clark, of Greymard, N. Y., who thought it contained a poison, several cows having died apparently from the effects of this feed.

No. 54. This was the common wild dandelion, growing abundantly upon the Station lawns. Broad-leaved type like the following one.

No. 55. The improved dandelion, grown by the Station, and was just at prime for cooking.

No. 56 was from the common pie-plant, of very succulent growth.

No. 57. Corn anthers holding the pollen.

Nos. 59–61. See description under "Edible Fungi."

No. 62. A sample of ragweed, *Ambrosia artemisiæfolia.* Sent on for analysis by E. W. Stewart, Lake View, N. Y.

FODDER ANALYSES.

Number.	FODDER.	Fresh Substance.						Dry Substance.				
		Water.	Ash.	Albuminoids, Nx 6.25.	Crude fiber.	Nitrogen free extract.	Fat (ether extract).	Ash.	Albuminoids, Nx 6.25.	Crude fiber.	Nitrogen free extract.	Fat (ether extract).
	GRASSES, ETC.											
1..	Medium red clover*	75.63	1.55	3.66	6.86	11.08	1.22	6.38	15.00	28.16	45.46	5.00
2..	Medium red clover	72.96	1.74	3.94	7.89	12.15	1.32	6.45	14.50	29.18	44.99	4.88
3..	Alsike clover*	77.29	1.95	3.66	5.32	10.76	1.02	8.57	16.12	23.45	47.36	4.50
4..	White clover*	78.23	1.79	4.42	4.70	9.44	1.42	8.24	20.31	21.60	43.33	6.52
5..	Bokhara clover*	80.55	1.27	3.04	6.79	7.22	1.13	6.51	15.63	34.94	37.11	5.81
6..	Lucerne*	56.73	3.77	6.49	14.81	16.47	1.73	8.71	15.00	34.24	38.04	4.01
7..	Lucerne	70.91	2.64	5.39	9.91	10.23	.92	9.09	15.50	34.08	38.16	3.17
8..	Yellow trefoil	78.52	1.37	3.40	6.31	9.29	1.11	6.40	15.81	30.31	42.31	5.17
9..	Timothy	71.36	1.36	1.34	8.56	16.54	.84	4.75	4.69	29.88	57.75	2.93
10..	Wood Meadow*	55.55	2.16	2.86	16.29	21.82	1.32	4.64	6.44	36.65	49.29	2.98
11..	Rough-stalked meadow*	......	......	......	......	......	......	6.21	8.75	33.46	47.72	3.91
12..	Chess*	60.35	1.83	3.17	13.05	20.46	1.12	4.67	8.00	32.91	51.60	2.82
13..	Ox-eye daisies*	78.46	1.59	1.28	5.62	12.16	.89	7.38	5.94	26.10	56.47	4.11
14..	Buttercup*	79.20	1.45	1.56	6.24	10.56	.99	7.02	7.50	30.00	50.72	4.76
15..	Timothy, average 21	57.31	2.08	3.23	13.38	22.64	1.36	4.92	7.79	31.75	52.36	3.18
16..	Timothy, average 3	48.14	2.25	3.28	18.16	26.72	1.45	4.32	6.31	35.03	51.55	2.79
17..	Red clover, average 21	68.34	2.05	4.51	9.71	14.03	1.30	6.50	14.23	30.70	44.46	4.11
	GREEN FODDERS.											
18..	Sorghum*	83.43	.74	1.04	5.76	8.56	.47	4.47	6.25	34.74	51.69	2.85
19..	Fodder corn*	70.74	1.79	2.45	11.40	12.75	.87	6.12	8.38	39.01	43.51	2.98
20..	Ensilage No. 1	60.72	1.65	3.54	7.83	23.90	2.36	4.20	9.00	19.94	60.84	6.02
21..	Ensilage No. 2	57.86	1.79	3.71	8.39	25.69	2.56	4.24	8.81	19.92	60.96	6.07
22..	Ensilage No. 3	60.51	2.75	3.30	13.60	17.51	2.33	6.96	8.37	34.45	44.32	5.90
23..	Prickly comfrey	88.24	1.64	1.88	2.66	5.27	.31	13.93	16.00	22.66	44.76	2.65
24..	Prickly comfrey	78.70	3.16	3.69	3.19	10.42	.84	14.83	17.31	14.98	48.91	3.97
25..	Prickly pear, top	......	......	......	......	......	......	22.79	6.81	14.99	52.92	2.49
26..	Prickly pear, stump	......	......	......	......	......	......	15.78	2.94	22.54	57.14	1.60

FODDER ANALYSES — (*Continued*).

Number.	FODDER.	Fresh Substance.						Dry Substance.				
		Water.	Ash.	Albuminoids. Nx 6.25.	Crude fiber.	Nitrogen free extract.	Fat (ether extract).	Ash.	Albuminoids. Nx 6.25	Crude fiber.	Nitrogen free extract.	Fat (ether extract).
	HAYS.											
27..	Alsike Clover	10.49	6.26	9.87	32.14	38.16	3.08	6.92	10.90	35.51	43.27	3.40
28..	Timothy, clover, etc.	9.32	6.19	9.25	32.13	39.85	3.26	6.77	10.12	35.12	44.43	3.56
29..	Hay	......	......	......	......	......	......	5.25	8.72	33.49	49.31	3.23
30..	Hay, mixed grasses	16.17	5.24	7.18	29.99	38.65	2.77	6.24	8.56	35.78	46.11	3.31
	STRAWS.											
31..	Wheat straw*	17.86	4.16	2.98	42.74	31.04	1.22	5.07	3.63	52.14	37.68	1.48
32..	Wheat chaff, hulls, etc.	25.62	9.13	2.79	26.49	35.01	.96	12.27	3.75	35.62	47.07	1.29
33..	Oat straw	16.28	4.83	2.35	36.77	37.97	1.80	5.80	2.81	43.92	45.32	2.15
34..	Oat chaff, hulls, etc.	11.54	16.26	5.80	24.05	39.80	2.55	18.38	6.56	27.19	44.99	2.88
35..	Corn fodder	39.02	4.38	2.86	21.72	30.78	1.24	7.19	4.69	35.62	50.46	2.04
36..	Corn fodder*	51.52	3.78	3.36	19.18	21.05	1.11	7.80	6.94	39.57	43.40	2.29
	GRAINS AND MEALS.											
37..	Oats	16.25	2.96	10.94	10.41	54.97	4.47	3.54	13.06	12.43	65.63	5.34
38..	Wheat*	12.80	1.40	13.00	3.76	67.40	1.64	1.60	14.93	4.31	77.28	1.88
39..	Wheat	13.83	1.74	10.61	2.43	69.74	1.63	2.02	12.31	2.84	80.94	1.89
40..	Flour	13.26	.38	10.50	1.21	73.62	1.03	.43	11.89	1.37	85.14	1.17
41..	Cernmeal	17.86	2.57	9.49	1.30	64.71	4.07	3.13	11.56	1.59	78.77	4.95
42..	Cornmeal*	16.96	1.39	8.56	1.98	66.92	4.19	1.67	10.31	2.38	80.60	5.04
	BY-PRODUCTS.											
43..	Wheat Middlings	14.04	3.45	16.44	3.56	57.69	4.82	3.93	18.75	4.06	67.77	5.49
44..	Wheat Bran	14.59	5.06	14.16	10.00	52.77	3.42	5.93	16.58	11.71	61.78	4.00
45..	Wheat Bran	......	......	......	......	......	......	7.17	16.84	11.65	59.65	4.69
46..	Wheat Bran	15.05	5.59	14.18	9.21	53.02	2.95	6.58	16.69	10.84	62.41	3.48
47..	Shipstuff	14.10	5.05	17.47	8.02	50.43	4.93	5.76	19.93	9.15	59.54	5.62
48..	Cottonseed Meal	......	......	......	......	......	......	7.34	52.09	6.21	23.72	10.64

49..	Linseed Meal	11.61	4.56	35.52	11.75	28.22	8.34	5.14	40.19	13.30	31.71	9.66
50..	Hominy Feed	12.06	2.61	11.56	5.02	63.31	5.44	2.92	12.95	5.62	72.42	6.09
51..	Gluten Meal	9.59	.85	21.92	5.54	51.77	10.33	.95	24.25	6.13	57.13	11.54
52..	Linseed Meal*	10.15	5.17	32.57	4.68	39.26	8.17	5.75	36.25	5.21	43.70	9.09
53..	Corncobs	21.55	1.55	1.22	31.60	43.84	.24	1.98	1.56	40.28	55.88	.30
	MISCELLANEOUS.											
54..	Dandelion, wild	88.32	1.74	2.86	1.69	4.67	.72	14.94	24.50	14.52	39.84	6.20
55..	Dandelion, improved	96.38	.62	.81	.59	1.39	.21	17.15	22.50	16.24	38.20	5.91
56..	Pie Plant	97.06	.48	.62	.65	1.10	.09	16.23	21.00	22.15	37.93	2.69
57..	Corn Anthers	......	......	......	......	......	......	5.76	17.19	10.03	65.97	4.05
58..	Castor Pomace	......	......	......	......	......	......	6.36	35.00	31.06	10.76	16.82
59..	Puff ball No. 1	92.18	.58	5.19	.89	1.05	.11	7.47	66.34	11.42	13.33	1.44
60..	Puff ball No. 2	......	......	......	......	......	......	6.97	57.44	11.07	22.05	2.47
61..	Mushrooms	89.15	.85	6.08	.76	2.37	.79	7.80	56.00	7.05	21.83	7.32
62..	Rag weed	......	......	......	......	......	......	8.69	15.44	31.46	38.70	5.71

ALBUMINOID AND NON-ALBUMINOID NITROGEN.

In a large majority of the fodders the albuminoid and non-albuminoid nitrogen was determined by Stutzer's cupric hydrate method, with such modifications as mentioned in my last report.

Number.		Date cut.	Total nitrogen.	Albuminoid nitrogen.	Amide nitrogen.	Per cent of total nitrogen in amide fo'm
	GRASSES.					
1..	Medium red clover	June 9	2.40	1.92	.48	20.00
2..	Medium red clover	" 18	2.32	2.04	.28	12.07
3..	Alsike clover	" 9	2.58	2.05	.53	20.54
4..	White clover	" 12	3.25	1.18	2.07	63.59
5..	Bokhara clover	July 1	2.50	.94	1.56	62.40
6..	Lucerne	June 15	2.40	1.72	.68	28.33
7..	Lucerne	" 29	2.48	1.88	.60	24.18
8..	Yellow trefoil	" 11	2.53	1.75	.78	30.83
9..	Timothy	" 28	.75	.38	.37	49.33
10..	Wood meadow grass	" 15	1.03	.87	.16	15.53
11..	Rough-stalked meadow	" 19	1.40	.51	.79	56.42
12..	Chess	" 19	1.28	.43	.85	66.40
13..	Daisies	" 7	.95	.50	.45	47.37
14..	Buttercups	" 7	1.20	1.13	.07	5.83
15..	Timothy (average 21)	" 29	1.24	1.07	.17	13.71
16..	Timothy (average 3)	July 14	1.01	.83	.18	17.82
17..	Red clover (average 21)	June ..	2.28	2.02	.26	11.40
	GREEN FODDER.					
18..	Sorghum	....	1	.71	.29	29.00
19..	Fodder corn	....	1.34	.90	.44	32.83
23..	Prickly comfrey	....	2.56	2.37	.19	7.42
25..	Prickly pear, top	....	1.09	.49	.60	55.04
26..	Prickly pear, stump	....	.47	.43	.04	8.51
	HAYS.					
29..	Hay	....	1.39	1.21	.18	12.94
	STRAW.					
31..	Wheat straw	....	.58	.53	.05	8.58
35..	Corn fodder	....	.75	.75	.0	.0
36..	Corn fodder	....	1.11	.84	.27	24.32
	GRAINS AND MEALS.					
38..	Wheat	....	2.39	1.41	.98	41.00
39..	Wheat	....	1.97	1.35	.62	31.47
40..	Flour	....	1.68	.84	.84	49.39
	BY-PRODUCTS.					
43..	Wheat middlings	....	2.63	1.92	.71	26.99
44..	Wheat bran	....	2.65	2.05	.60	22.64
45..	Wheat bran	....	2.69	2.09	.60	22.30
47..	Shipstuff	....	2.80	2.19	.61	21.79
48..	Cottonseed meal	....	8.34	7.90	.44	5.27
52..	Linseed meal	....	6.43	6.15	.27	4.20
53..	Corn cobs	....	.25	.24	.01	4.10
	MISCELLANEOUS.					
54..	Dandelion, wild	....	3.92	2.72	1.20	30.61
55..	Dandelion, improved	....	3.60	2.25	1.35	37.50

SUGARS AND STARCH.

In a few of the samples mentioned in this table of analyses, the sugars and starch have been determined by the method given under "Methods of Analysis." Where only starch appears in the table it includes the sugars, no separate determination of these having been made.

No.	SUBSTANCE.	Invert sugar.	Sucrose.	Starch.	Per cent of nitrogen free extract, as sugars and starch.
5	Bokhara clover	......	......	10.34	27.83
15	Timothy (average 21)	2.23	6.21	19.72	55.69
16	Timothy (average 3)	2.31	4.87	22.31	57.07
17	Red clover (average 21)	3.88	2.48	9.38	35.40
18	Sorghum	27.60	3.40	12.19	64.21
19	Fodder corn	9.00	.40	13.87	53.48
23	Prickly comfrey	6.22	.80	8.14	33.87
25	Cactus, top	.0	5.92	9.96	30.00
26	Cactus, stump	2.80	3.60	17.10	41.12
27	Alsike clover	......	......	14.63	33.81
29	Hay	......	......	24.32	49.32
30	Hay, mixed	......	......	20.90	45.33
31	Wheat straw	......	......	22.42	59.52
33	Oat straw	......	......	23.18	51.14
35	Corn fodder	2.50	1.43	22.88	53.32
37	Oats	.....	......	53.20	81.05
39	Wheat	1.64	2.36	57.91	76.37
40	Flour	3.64	8.36	61.88	86.77
	Corn meal	......	......	71.97	88.69
43	Wheat middlings	3.20	6.40	41.44	75.31
44	Wheat bran	1.60	4.40	45.60	83.53
46	Wheat bran	......	....	50.54	80.98
47	Shipstuff	2.08	5.92	41.46	83.07

DIGESTIBILITY.

No.		Crude albuminoids, Nx 6.25.	True albuminoids.	Per cent undigested.	Per cent crude albuminoids digested.	Per cent true albuminoids digested.
	GRASSES, ETC.					
1..	Medium red clover	15.00	12.00	5.25	65.00	56.25
2..	Medium red clover	14.50	12.75	3.56	75.44	72.00
3..	Alsike clover	16.12	12.81	4.62	71.34	63.93
4..	White clover	20.31	7.38	5.06	75.08	31.43
5..	Bokhara clover	15.63	5.88	3.73	78.44	42.66
6..	Lucerne	15.00	11.75	4.06	72.93	65.44
7..	Lucerne	15.50	10.75	3.31	77.93	69.21
8..	Yellow trefoil	15.81	10.94	3.75	76.28	65.71
9..	Timothy	4.69	2.38	2.06	56.08	13.44
10..	Wood meadow	6.44	5.44	2.06	68.10	62.13
11..	Rough-stalked meadow	8.75	3.81	2.50	71.43	34.38
12..	Chess	8.00	2.69	2.25	71.87	16.36
13..	Daisies	5.94	3.13	4.25	28.45	....
14..	Buttercups	7.50	7.06	3.50	53.33	50.42
15..	Timothy (average 21)	7.79	6.19	3.62	52.49	43.88
16..	Timothy (average 3)	6.31	5.54	4.06	39.39	....
17..	Red clover (average 21)	14.23	12.65	6.03	57.62	52.33
	GREEN FODDERS.					
18..	Sorghum	6.25	4.44	2.63	57.92	40.76
19..	Fodder corn	8.38	5.63	3.94	52.98	30.01
20..	Ensilage No. 1	9.00	......	3.13	65.22	....
21..	Ensilage No. 2	8.81	......	3.69	58.11	....
22..	Ensilage No. 3	8.37	......	3.25	61.18	....
23..	Prickly comfrey	16.00	14.81	10.87	32.06	26.60
25..	Prickly pear, top	6.81	3.16	2.68	60.64	15.23
26..	Prickly pear, stump	2.94	2.69	2.62	10.88	....
	HAYS.					
27..	Alsike clover	9.87	......	4.88	50.50	....
28..	Timothy, clover, etc	10.12	......	3.56	64.82	....
29..	Hay	8.72	7.56	4.89	44.00	35.31
30..	Hay, mixed grasses	8.56	......	5.12	40.18	....
	STRAW.					
31..	Wheat straw	3.63	3.31	2.75	25.27	16.91
32..	Wheat chaff, hulls, etc	3.75	3.69	2.50	33.33	32.52
33..	Oat straw	2.81	......	2.31	17.79	....
34..	Oat chaff, hulls, etc	6.56	......	5.31	19.05	......
35..	Corn fodder	4.69	4.68	3.25	30.55	30.55
36..	Corn fodder	6.94	5.25	3.19	54.03	39.23
	GRAINS AND MEALS.					
37..	Oats	13.06	......	2.44	81.31	....
38..	Wheat	14.93	8.81	1.93	87.07	78.09
39..	Wheat	12.31	8.44	1.50	87.81	82.22
40..	Flour	10.50	5.25	1.06	89.90	79.81
41..	Corn meal	11.56	......	4.31	62.71	....
42..	Corn meal	10.31	7.81	3.37	67.32	56.85
	BY-PRODUCTS.					
43..	Wheat middlings	16.44	12.00	1.75	89.35	85.41
44..	Wheat bran	16.58	12.81	2.81	83.03	78.06
45..	Wheat bran	16.84	13.06	3.55	78.92	72.81
46..	Wheat bran	16.69	......	3.25	79.92	....
47..	Shipstuff	17.50	13.68	2.81	83.94	79.46
48..	Cotton seed meal	52.09	49.37	7.38	85.84	85.05
50..	Hominy feed	11.56	......	4.06	64.88	....
52..	Linseed meal	40.19	......	4.06	89.87	....
53..	Corn cobs	1.56	1.50	1.06	32.05	29.20

ASH ANALYSIS.

No.		Ash.	Phosphoric acid, $P_2 O_5$.	Potash. $K_2 O_3$.	Soda, $Na_2 O$.	Lime. Ca O.	Magnesia. Mg O.
1..	Medium red clover..	6.38	7.20	16.39	0.32	25.46	5.69
3..	Alsike clover........	8.57	5.20	33.42	....	25.93	4.62
4..	White clover........	8.24	7.49	26.04	0.92	......	....
5 .	Bokhara clover......	6.51	5.17	13.98	0.38	35.73	4.04
6..	Lucerne..............	8.71	6.29	18.84	1.15	37.07	2.16
8..	Yellow trefoil........	6.40	7.88	18.00	2.78	33.36	3.56
9..	Timothy..............	4.75	4.41	27.02	1.62	......	....
10..	Wood meadow......	4.64	6.50	18.32	11.34	.....	....
11..	Rough-stalk'd m'dow	6.21	6.26	31.47	5.22	16.93	3.96
12..	Chess................	4.67	6.38	17.45	......	......	....
13..	Ox-eye daisies......	7.38	4.32	35.70	1.01	......	....
14..	Buttercups..........	7.02	6.86	13.66	18.32	......	....
15..	Timothy (average 16)	4.99	5.93	34.19	5.45	8.69	1.93
16..	Timothy (average 3).	4.32	5.92	23.33	8.23	10.69	....
17..	Red clover (av'ge 6)..	6.49	4.51	20.38	8.51	29.98	4.23
18..	Fodder corn.........	6.12	5.17	23.94	19.84	25.36	4.84
19..	Alsike clover........	6.72	6.17	21.50	1.26	......	....
31..	Wheat straw...	5.07	2.45	12.60	5.47	5.68	1.52
33..	Oat straw............	5.80	1.17	27.76	4.82	9.28	.95
35..	Corn fodder.........	7.19	1.79	12.05	15.60	12.33	4.63
37..	Oats.................	3.54	41.68	12.53	1.13	3.33	2.63
38..	Wheat...............	1.60	44.08	18.73	1.12	......	....
39..	Wheat...............	2.02	47.93	27.98	6.16	4.19	6.76
40..	Flour................	.43	52.32	30.94	2.60	7.40	4.45
42..	Corn meal...........	1.67	54.48	28.53	6.79	2.64	6.83
43..	Wheat middlings....	3.93	50.08	18.22	0.15	1.83	2.24
22..	Wheat bran.........	5.93	50.50	16.63	1.58	2.50	7.00
47..	Shipstuff............	5.76	40.68	19.52	1.96	2.50	5.94
48..	Cottonseed meal.....	7.34	43.56	29.04	10.00	4.08	6.52
52..	Linseed meal........	5.75	36.68	22.00	9.96	11.36	7.85
53..	Corn cobs...........	1.98	0.36	51.48	2.08	1.76	.96
25..	Prickly pear, top....	22.79	1.10	13.88	10.56	37.28	4.20
26..	Prickly pear, stump.	15.78	0.20	16.72	13.64	35.12	4.01
....	Beet, Mammoth Red	19.55	4.78	41.25	3.80	1.68	1.47

WHEAT AND ITS PRODUCTS.

1. WHEAT STRAW.
2. WHEAT GRAIN.
3. FLOUR.
4. MIDDLINGS.
5. SHIPSTUFF.
6. BRAN.
7. SUMMARY.

In the State of New York alone it is estimated that there were grown last year nearly 12,000,000 bushels of wheat. Therefore a study of the chemical composition of wheat and its products, and of the amount of fertilizing matter (nitrogen, phosphoric acid and potash) removed from the soil by the crop, becomes of direct interest, not only to the producer from whose soil these ingredients are removed, but to the consumer as well, who desires to know what proportion of these elements of fertility he is returning to his own soil in the different products he may use as animal feed.

It is desirable to determine what is the average composition of wheats and the flour made from them for this section of our country, and to see in what direction efforts should be turned to improve the present varieties in order to produce the best quality of flour. This can only be done after we determine what variation there is for different years due to meteorological influences and variation in soils, for it has been shown by Richardson that environment very largely influences the quality of wheat. When these have been determined, then we may hope to be able to determine which factors, under our control, enter in to permanently improve the better flour-producing quality of wheats.

WHEAT STRAW.

Our analyses for straw having already been given, No. 31, in the preceding tables, need not here be repeated, but straw having a composition like the one we have examined, would contain in one ton, the following amounts:

	Pounds.	
Water	357.2	
Ash	83.2	
Albuminoids	59.6	
Crude fiber	854.8	
Nitrogen free extract	620.8	
Fat (ether extract)	24.4	
Starch and sugars		44.84
Nitrogen, N		11.20
Phosphoric acid, P_2O_5		2.67
Potash, K_2O		13.76
Lime, CaO		6.20

WHEAT GRAIN.

For analyses of wheats, see preceding tables, Nos. 38 and 39.

From the average of our analyses for New York grown winter wheat we find there would be removed per bushel, the following amounts:

	Pounds.
Water	7.93
Ash	.94
Albuminoids	7.08
Crude fiber	1.86

	Pounds.	
Nitrogen free extract	41.15	
Fat (ether extract)	.97	
Invert sugar, glucose, etc		.784
Sucrose, etc		1.416
Starch		34.314
Nitrogen, N		1.026
Phosphoric acid, P_2O_5		.454
Potash, K_2O		.265
Lime, Ca O		.040

From experiments made at one of the mills using the Hungarian roller process, we are informed that one bushel (60 lbs.) of winter wheat, grown in this vicinity, furnished on the average about the following proportion of products:

	Pounds.
Flour	44
Middlings	4
Ship stuff	2
Bran	10

Samples of these different products were taken at the mill, and each has been carefully analyzed. These analyses, together with the above data, furnish us a means of estimating the amount of the different ingredients removed in the various products in one bushel of wheat, having a composition like the samples we have examined. The wheat from which these products were manufactured, was a mixture in about equal proportions of Clawson, Mediterranean and Early Amber.

FLOUR.

The analyses for this flour are given, No. 40 of the preceding tables. The flour, 44 pounds, from one bushel of wheat having a composition like the samples analyzed would contain the following amounts:

	Pounds per bushel of wheat.
Water	5.834
Ash	.167
Albuminoids	4.620
Crude fiber	.532
Nitrogen free extract	33.391
Fat (ether extract)	.453

Invert sugar, glucose, etc	1.601
Sucrose, etc	3.678
Starch, etc	27.227
Nitrogen, N	.739
Phosphoric acid, P_2O_5	.092
Potash, K_2O	.054
Lime, Ca O	.013

WHEAT MIDDLINGS.

The middlings form the inner coating of the wheat next the floury or starchy portion and contain portions of the germ and a larger per cent of nitrogen free extract, particularly starch, than either shipstuff or bran, and a less per cent of fiber, while the per cent of albuminoids usually stands between that of shipstuff and bran. The analysis No. 43, already given, furnishes the data for the following at 4 lbs. to the bushel of wheat:

	Pounds per bushel of wheat.	
Water	.562	
Ash	.138	
Albuminoids	.657	
Crude fiber	.142	
Nitrogen-free extract	2.307	
Fat (ether extract)	.193	
Invert sugar, glucose, etc		.128
Sucrose		.256
Starch		1.875
Nitrogen, N		.105
Phosphoric acid, P_2O_5		.067
Potash, K_2O		.024
Lime, Ca O		.002

SHIPSTUFF.

That part separated and known as shipstuff is a very thin layer next outside of the middlings, and contains the germ not found in the middlings or left as a part of the flour. The quantity produced, two pounds from a bushel of wheat, is very small and rarely kept separate from the bran. For analysis see preceding tables, No. 47.

	Pounds in bushel wheat.	
Water	.282	
Ash	.101	
Albuminoids	.349	
Crude fiber	.160	
Nitrogen free extract	1.088	
Fat (ether extract)	.099	
Invert sugar, glucose, etc		.042
Sucrose		.118
Starch		.776
Nitrogen, N		.056
Phosphoric acid, $P_2 O_5$		.044
Potash, $K_2 O$		.021
Lime, Ca O		.003

BRAN.

Bran, the outer coating of the wheat, contains twice or three times as much fiber as does either of the other products from wheat, and proportionately less of each of the other ingredients except ash, which is greater, perhaps partly due to foreign matter adhering to the kernel. The analysis already given, No. 44, I need not repeat here, but give the amount removed by the bran (ten pounds) from one bushel of wheat:

	Pounds from bushel wheat.	
Water	1.459	
Ash	.506	
Albuminoids	1.416	
Crude fiber	1.000	
Nitrogen free extract	5.277	
Fat (ether extract)	.342	
Invert sugar, glucose, etc		.160
Sucrose		.440
Starch, etc		4.644
Nitrogen		.228
Phosphoric acid, $P_2 O_5$		.251
Potash, $K_2 O$		.083
Lime, Ca O		.012

SUMMARY.

According to Richardson * the average per cent of water for American winter wheats is 10.16 against 13.22 for the samples we have ana-

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* Bull. Department Ag., No. 4, p. 30.

lyzed, while the per cent of albuminoids,* according to the same authority, averages for America 12.15. For New York we find 11.80 per cent, but only approximate comparisons can now be made until a larger number of wheats have been analyzed, for in albuminoids the two wheats examined show a wide variation, and although grown in the same locality, but upon different soils, we cannot say whether this variation is due to difference in variety and soil or to meteorological influences, since they were grown in different years, for it has been shown that both may influence to a considerable extent the composition and physical properties of wheat.

Two-thirds of the nitrogen of the grain remains as a part of the flour, but of the mineral elements, phosphates, potash, etc., the larger proportion is left in the by-products, which are used as animal feeds, only about one-fifth of the phosphates being in the flour, the largest part being in the bran.

The high coëfficient of digestibility for the by-products from flour production renders them a most valuable source of animal feed, and at the same time so concentrated and rich are they in those elements necessary to a fertile soil that they become when properly managed a valuable source of fertilizers. From the foregoing we find that the milling products from one bushel of wheat having a composition like our sample would contain the following amounts of fertilizing matter, expressed in pounds:

	Nitrogen.	Phosphoric acid. P_2O_5.	Potash. K_2O.	Lime. CaO.
Flour	.739	.092	.054	.013
Middlings	.105	.064	.024	.002
Shipstuff	.056	.044	.021	.003
Bran	.228	.251	.083	.012
Totals	1.118	.454	.182	.030

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* Agricultural Science, Vol. I, No. 6, p. 126.

Or we may express the results in another form, calculating the amount contained in one ton of straw and the products of thirty bushels of wheat, expressing the amounts in pounds, as follows:

	Nitrogen.	Phosphoric acid P_2O_5.	Potash. K_2O.	Lime. CaO.
Straw	11.20	2.67	13.76	6.20
Flour	22.17	2.76	1.62	.39
Middlings	3.15	2.01	.72	.06
Shipstuff	1.68	1.32	.63	.09
Bran	6.84	7.53	2.49	.36
Totals	45.04	16.29	19.22	7.10

During another year we hope to be able to further study the variation in, and influence of soil and fertilizers upon, the composition of wheat, together with the meteorological influences.

PER CENT OF WATER IN SOME FARM PRODUCTS.

1. VARIETIES OF GRASS IN FULL BLOOM.
2. IN HAY, STORED IN MOWS.
3. IN FODDER CORN.
4. IN CORN FODDER; STOVER.
5. IN CORN MEAL.

No exact data seems to be accessible as to the per cent of water contained in many of our common feeding stuffs, in different localities and at different times in the year. That the amount varies for localities and for different years in the same locality, as well as for the different seasons of the year according to time from harvesting, there is little question.

A few determinations of the water in various products have been made from time to time during the past two years, and some of the results are given in this topic.

WATER IN GRASSES IN FULL BLOOM.

For two years I have taken for analysis samples of different grasses at the period of full bloom, and give in parallel columns the per cent of water as determined at that time. The samples were taken at the same place each year and were mostly from the Station grass-plats:

	Per cent of water. 1886.	Per cent of water. 1887.
Timothy (Herdsgrass)	71.36	59.85
Orchard grass	65.00	73.19
Tall Meadow oat grass	69.07	69.86
Fort Bellingham	61.78	63.38
Reed Canary grass	65.23	66.52
Meadow Fescue	68.70	66.52
Lucerne: Alfalfa	56.73	70.91
Medium Red Clover	75.63	72.96

It will be observed from the above table that there may be a considerable variation in the amount of water for the same kind of grass for different years at the same stage of growth, also between the different varieties for the same year, but, on the whole, the amount of water in the grasses at date of harvesting was greater in 1887 than in the preceding year.

AMOUNT OF WATER IN HAY.

The amount of water contained in hay, in mows, during the feeding season, is one of considerable importance, especially to those who have to buy hay, and probably varies according to locality. I have brought together here the data gathered from my own determinations, using only those results where the conditions of sampling were known, and the most of the samples were taken for the purpose of water determination. Considerable of the surface hay was removed before taking the sample, in order to avoid, as far as possible, surface hygroscopic influences. The hays were dried at about 100° C, until the weight was constant and the loss calculated as water:

			Per cent of water.
September	3.	Clover and timothy	14.77
November	4.	Mixed hay, two years in mow	16.04
November	29.	Hay from mow, loft of barn	15.41
January	31.	Hay from mow	14.98
February	1.	Hay from mow, loft of barn	16.27
February	7.	Hay from horse barn	15.35
February	24.	Hay in mow, one year past	13.94
March	4.	Hay from horse barn	16.02

The above for a single year's determination shows for hay in the locality of the Station as found in mows an average of 15.35 per cent of water, a minimum of 13.94 (old hay) and a maximum of 16.27 per cent.

FODDER CORN.

The water content of fourteen samples of fodder corn was determined at the period of growth when cut for filling the silo, several varieties being represented by the different plats. Without giving each determination in full, the following summary is presented:

	Per cent of water.
Average	82.14
Maximum	86.83
Minimum	69.28

CORN FODDER: STOVER.

Determinations of the amount of water in corn fodder have been made at irregular intervals from the time of harvesting in the fall until spring. The first one is for a sample taken in the field at the time of husking the corn; the others are a series of determinations made with samples taken from the same general pile, stored for feeding in the experiment barn loft. A bundle of stalks was run through a feed cutter, the whole well mixed and then sampled:

	Per cent of water.
October 12	51.52
November 3	34.98
November 29	39.19
December 17	31.29
January 6	28.65
January 18	28.88
January 31	33.14
February 7	33.54
February 24	25.92
March 28	26.12

CORN MEAL.

The per cent of water in corn meal varies considerably, according to the method of storage for the corn and the time from harvesting. In each case the date at which the sample was taken is given, and these were taken at irregular periods from time of harvesting through the year. The determinations are for all the meals analyzed, and include both that made from Station-grown corn and that purchased for feeding, and are not all for the same year, but are arranged according to the dates:

	Per cent of water.
October 27	25.55
December 18	27.41
December 28	16.96
January 9	22.56
February 3	23.14
February 14	17.86
March 17	15.80
April 17	11.09
July 10	10.25
July 1	8.01
July 6	11.00
July 6	9.63
August 6	9.29
September 11	10.25

The corn meals under date of August 6 were from different varieties of corn which had been spread upon the chamber floor in the barn since harvesting and in a most favorable condition for a minimum amount of moisture. Those under date of October 27, December 28 and April 17 were from samples from the same corn put up in traces at time of harvesting and hung to the rafters in the barn loft.

NEW vs. OLD HAY AND GRAIN.

A sample of timothy hay, the crop of 1886, of which a portion had been analyzed and the digestibility of its albuminoids determined in the early winter of 1886, was put in a cotton bag and hung up in the barn loft, where it remained until October, 1887, when it was examined as to the digestibility of its albuminoids. The result of this examination was as follows:

	Per cent of albuminoids digested.
New hay	67.39
Old hay	55.10

From the above we find that the nutritive value of the hay was considerably diminished on long keeping, and this led us to make similar examinations of samples of wheat and of wheat bran that had been ground and kept in the laboratory in glass-stoppered bottles for ten months:

	Per cent digested.	
	Fresh.	Old.
Wheat bran	83.03	77.37
Wheat	87.81	79.20

We find that the digestibility of wheat and bran has also been considerably diminished by keeping, and while we have made no further investigations as to other changes or digestibility of constituents other than albuminoids, yet from previous experiments there seems good reason for believing that the fats at least would be found less digestible in the old grains than in the fresh grains themselves, especially if they have been reduced to meal. The amount of fats* soluble in either is markedly less in grains eighteen months old than in those but a short time from harvesting and freshly ground.

The insolubility of the oils in ether is due to their oxidation, and it seems probable that they would be found also less digestible. Should further investigation confirm these trials this would furnish an explanation for the decreased value of old hay and grain over that in the winter immediately following its harvesting, a fact long recognized by the farmer, but often overlooked by the chemist.

INFLUENCE OF FERTILIZERS UPON THE COMPOSITION OF TIMOTHY AND CLOVER.

In order to study the influence of various fertilizing substances upon the composition of grasses, a lot was selected in a field which had already been down to grass for five years. This lot was divided into twenty-one plats, each ten by fifteen feet, and different fertilizing ingredients applied to the several plats, in the proportion indicated by the first table.

There are but few questions of greater importance to the agriculturist, or more difficult of investigation for the agricultural chemist, than that for determining the influence of the various fertilizing elements through the soil upon the composition and digestibility of our feeding stuffs. Few agricultural problems can be more complex, and have more influencing factors entering in to modify the results, than we find in this line of work. Soil, temperature, rainfall, evaporation, sunshine, locality, etc., each influences the growth and composition of plants, and only after a long series of experiments can any investigation in this direction lead to definite conclusions. From this year's results we do not expect to be able to settle any mooted questions, but rather to add cumulative data, which shall ultimately help throw light upon such questions as the influence which the various fertilizers, singly and combined, exert in the soil, and through the soil upon the plant.

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* See report New York Agricultural Experiment Station, 1885, p. 319.

The fertilizers were mixed with fine, dry sand before being applied in order to insure a more uniform distribution over the surface of the plats. The lot selected for experiment was as nearly uniform in general appearance at time of sowing the fertilizers, May 3, as could have been expected.

FERTILIZER—POUNDS PER ACRE.

PLAT.	Sulphate of potash.	Muriate of potash.	Sulphate of ammonia.	Nitrate of soda.	Acid phosphate.	Ferrous sulphate.	Lime.	Gypsum.	Sodium chloride.
I	300	....	....	....	....	....	....	....	....
II	....	....	150	....	....	....	....	....	....
III	....	....	....	....	350	....	....	....	....
IV	300	....	150	....	350	....	....	....	....
V	300	....	....	....	350	....	....	....	....
VI	....	....	150	....	....	....	....	....	....
VII	....	....	150	....	350	....	....	....	....
VIII	....	....	150	....	350	....	350	....	....
IX	300	....	150	....	....	....	350	....	....
X	300	....	150	...	350	....	350	....	....
XI	....	....	150	....	....	....	350	550	....
XII	300	....	150	....	350	....	....	550	....
XIII	....	....	....	....	....	....	350	....	....
XIV	....	....	....	....	....	....	....	550	....
XV	....	....	....	....	....	....	....	....	....
XVI	....	....	....	....	....	....	....	....	100
XVII	....	....	....	180	....	....	....	....	....
XVIII	....	....	150	....	....	....	....	....	....
XIX	....	150	....	....	....	....	....	....	....
XX	300	....	....	....	....	....	....	....	....
XXI	....	....	....	....	....	50	....	....	....

The lot, like the surrounding field, was covered with a good growth of timothy and some red clover. The application of the nitrogenous fertilizers tended to stimulate the growth of the clover, so that on those plats where nitrogen was applied, there was a large increase in the proportion and growth of the clover.

The notes taken under date of June 9 will indicate the general appearance of the plats at that date.

No. 1. Grass nearly the same in general appearance as the surrounding field.

No. 2. Grass thicker, further advanced, and of a deeper color, with more clover than in No. 1.

No. 3. In appearance more nearly as No. 1.

No. 4. Resembles No. 2.

No. 5. Not nearly so good as No. 4, but better than No. 1.

No. 6. Some better than last.

No. 7. Not so good as No. 5.

No. 8. Color pale for timothy, but a good growth.

No. 9. Not so good as last. Color about the same.

No. 10. Very good. Stronger growth than No. 2, but not so far advanced.

No. 11. Smaller growth, and not so thick, but in appearance better than No. 1.

No. 12. Not so good as No. 10.

No. 13. Very poor growth of timothy, and but few heads as yet appearing, with but very little color.

No. 14. Better than the last.

No. 15. Color pale, but growth superior to 13.

No. 16. In appearance not so good as 15, but color rather better.

No. 17. Thickest growth in lot, deepest color, but not so far advanced as the others.

No. 18. Good color, but in all respects far behind No. 17.

No. 19. About as No. 1.

No. 20. No noticeable difference from last.

No. 21. Resembles the last two, or about the same as surrounding field.

These notes are given to show the general impression on carefully looking over the plats, and the relative positions which they held at this date was not materially changed at time of taking the samples. As would be expected in dealing with a large number of plats receiving different treatment, they could not all be collected in exactly the same stage of growth on any one date, but at time of sampling they were all as nearly in full bloom as was possible to have them at any one time.

RED CLOVER HAY.

June 23, the samples of red clover were taken for analysis. The whole plant above ground was taken, and a sufficiently large sample to insure having a fair representative of the plat. The samples were carefully dried at 100 C., then ground and preserved for analysis.

RED CLOVER.

PLAT.	Fresh Substance.						Water-Free.				
	Water.	Ash.	Albuminoids Nx 6.25.	Crude fiber.	Nitrogen free extract.	Fat (ether extract).	Ash.	Albuminoids Nx 6.25.	Crude fiber.	Nitrogen free extract.	Fat (ether extract).
I.	67.45	1.98	4.54	9.19	15.50	1.34	6.10	13.94	28.23	47.62	4.11
II.	65.97	2.15	4.44	10.35	15.80	1.29	6.32	13.06	30.41	46.31	3.80
III.	67.20	2.20	4.76	10.13	14.41	1.30	6.71	14.50	30.89	43.93	3.97
IV.	69.91	2.02	4.55	9.64	12.64	1.24	6.73	15.11	32.03	41.99	4.14
V.	69.77	2.05	4.38	9.04	13.50	1.26	6.79	14.50	29.91	44.62	4.18
VI.	68.10	2.06	4.53	10.70	13.34	1.27	6.47	14.19	33.56	41.81	3.97
VII.	65.83	2.15	5.06	11.31	15.26	1.39	6.28	14.81	30.19	44.66	4.06
VIII.	67.43	2.06	4.82	9.78	14.44	1.27	6.32	14.81	30.02	44.94	3.91
IX.	68.42	2.07	4.34	9.51	14.30	1.36	6.55	13.75	30.11	45.29	4.30
X.	71.15	1.89	4.34	8.46	13.01	1.15	6.56	15.06	29.32	45.07	3.99
XI.	70.10	1.99	4.30	8.68	13.96	.97	6.67	14.37	29.04	46.67	3.25
XII.	68.37	2.10	4.21	9.05	15.12	1.15	6.64	13.31	28.63	47.77	3.65
XIII.	66.54	2.15	4.27	10.57	14.93	1.34	6.42	12.75	31.59	44.63	4.61
XIV.	68.64	2.03	4.00	9.83	14.24	1.23	6.50	12.75	31.36	45.47	3.92
XV.	71.02	1.80	3.80	8.83	13.38	1.17	6.23	13.12	30.48	46.14	4.03
XVI.	68.10	2.15	4.76	10.04	13.82	1.13	6.74	14.94	31.49	43.27	3.56
XVII.	69.80	1.91	4.21	9.16	13.62	1.30	6.33	13.94	30.35	45.07	4.31
XVIII.	69.66	2.05	4.44	8.95	13.59	1.31	6.76	14.62	29.50	44.80	4.32
XIX.	66.37	2.26	5.63	10.84	13.45	1.45	6.72	16.75	32.25	39.98	4.30
XX.	66.80	2.12	4.67	10.94	13.71	1.76	6.39	14.06	32.97	41.29	5.29
XXI.	68.67	1.97	4.58	10.15	13.19	1.44	6.28	14.62	32.40	42.10	4.60
Average	68.34	2.05	4.51	9.77	14.03	1.30	6.50	14.23	30.70	44.46	4.11

ALBUMINOID AND NON-ALBUMINOID NITROGEN.

The albuminoid and non-albuminoid nitrogen of the clover was determined for each plat by Stutzer's method, and the results are given below:

PLAT.	Total nitrogen.	Albuminoid nitrogen.	Amide nitrogen.	Per cent of total nitrogen in amide form.
I	2.23	2.13	.10	4.48
II	2.09	1.99	.10	4.78
III	2.32	2.04	.28	12.07
IV	2.42	2.08	.34	14.05
V	2.32	2.11	.21	9.05
VI	2.27	1.99	.28	12.33
VII	2.37	2.18	.19	8.01
VIII	2.37	2.13	.24	10.12
IX	2.20	2.01	.19	8.63
X	2.41	2.13	.28	11.61
XI	2.30	1.94	.36	15.65
XII	2.13	2.01	.12	5.63
XIII	2.04	1.75	.29	13.72
XIV	2.04	1.94	.10	4.90
XV	2.10	1.87	.23	10.95
XVI	2.39	2.16	.23	9.62
XVII	2.23	2.08	.15	6.72
XVIII	2.34	2.08	.26	11.11
XIX	2.68	1.99	.69	25.74
XX	2.25	1.88	.37	16.44
XXI	2.34	2.06	.28	11.96
Average	2.28	2.02	.26	11.40

SUGARS AND STARCH.

In each case the per cent of sugars and starch was determined in the dry substance, by the method indicated in another topic, and for convenience the terms invert sugar, sucrose and starch will be used.

PLAT.	Invert sugar.	Sucrose.	Starch.	Per cent of nitrogen free extract, as sugar and starch.
I	4.08	2.60	9.88	34.77
II	3.52	2.16	9.23	32.19
III	4.60	2.20	5.58	27.72
IV	5.20	1.20	8.04	34.39
V	5.00	.88	10.52	36.75
VI	5.60	2.40	6.46	34.57
VII	2.60	3.80	10.41	37.64
VIII	3.20	2.04	9.25	32.24
IX	4.80	2.12	8.43	33.89
X	4.20	2.88	9.80	37.42
XI	4.00	2.96	10.79	38.03
XII	2.64	2.24	13.90	39.31
XIII	3.40	1.80	12.35	39.32
XIV	3.80	4.40	6.08	31.40
XV	4.00	3.40	9.04	35.63
XVI	3.20	3.92	7.22	33.14
XVII	3.32	1.72	11.32	36.29
XVIII	4.00	2.20	11.40	39.28
XIX	3.60	2.40	6.84	32.11
XX	3.20	2.00	12.92	43.88
XXI	3.60	2.80	7.48	32.97
Average	3.88	2.48	9.38	35.40

Digestibility.

The digestibility of the albuminoids was determined in each case by pepsin digestion. A marked difference in digestibility is shown for the different plats, the coëfficient ranging from 38 to 72 per cent.

PLAT.	Total albuminoids.	True albuminoids.	Per cent undigested.	Per cent total albuminoids digested.	Per cent true albuminoids digested.
I	13.94	13.21	8.31	40.39	37.09
II	13.06	12.44	5.75	55.97	53.78
III	14.50	12.75	5.31	63.37	58.35
IV	15.11	13.00	5.75	61.94	55.77
V	14.50	13.19	9.00	37.93	31.76
VI	14.19	12.44	4.87	66.45	60.85
VII	14.81	13.62	6.50	56.11	52.24
VIII	14.81	13.21	6.63	55.23	49.81
IX	13.75	12.56	4.87	64.58	61.22
X	15.06	13.31	4.12	72.64	69.04
XI	14.37	12.12	5.75	59.98	52.56
XII	13.31	12.56	5.19	61.00	58.67
XIII	12.75	10.94	7.25	43.13	33.73
XIV	12.75	12.12	5.50	56.73	54.62
XV	13.12	11.69	5.62	57.16	51.92
XVI	14.94	13.50	5.31	63.79	60.66
XVII	13.94	13.00	6.12	56.09	52.92
XVIII	14.62	13.00	6.44	55.95	50.46
XIX	16.75	12.44	6.12	63.46	50.80
XX	14.06	11.75	6.56	53.34	44.17
XXI	14.62	12.87	5.62	61.56	56.33
Average	14.23	12.65	6.03	57.62	52.33

ASH ANALYSIS.

In a few of the samples the principal ash constituents were determined and are given in the following table:

PLAT.	Ash.	Phosphoric acid. $P_2 O_5$.	Potash. $K_2 O$.	Soda. $Na_2 O$.	Lime. $Ca O$.	Magnesia $Mg O$.
I......	6.10	3.73	16.60	16.76	27.28	4.16
II.......	6.32	2.92	18.24	5.64	33.44	4.29
III.......	6.71	6.08	16.64	10.64	36.40	5.16
IV.......	6.73	5.57	28.03	7.56	25.20	3.50
V.......	6.79	4.96	19.40	3.28	29.44	3.28

ASH CONSTITUENTS CALCULATED IN DRY SUBSTANCE OF HAY.

The results can best be compared if the ash elements be calculated upon the hay itself, thus enabling us to trace real differences, which may not exist in the ash composition itself.

PLAT.	Phosphoric acid. $O_2 P_5$.	Potash. $K_2 O$.	Soda. $Na_2 O$.	Lime. $Ca O$.	Magnesia. $Mg O$.	Nitrogen.
I........................	227	1.013	1.022	1.664	.254	2.23
II........................	.184	1.153	.356	2.113	.271	2.09
III........................	.408	1.116	.714	2.342	.346	2.32
IV........................	.375	1.886	.509	1.696	.235	2.42
V........................	.337	1.317	.233	1.999	.233	2.33

TIMOTHY.

June 29, the samples of timothy were taken for analysis, and the data from the results are given in the following table:

ANALYSIS OF TIMOTHY.

	FRESH SUBSTANCE.						WATER FREE.				
	Water.	Ash.	Albuminoids Nx 6.25.	Crude fiber.	Nitrogen free extract.	Fat (ether extract).	Ash.	Albuminoids Nx 6.25.	Crude fiber.	Nitrogen free extract.	Fat (ether extract).
I.	60.86	1.69	2.72	12.18	21.47	1.18	4.33	6.94	31.13	54.57	3.03
II.	55.32	1.83	3.35	14.49	23.79	1.22	4.09	7.50	32.43	53.25	2.73
III.	58.12	2.14	3.14	13.69	21.38	1.53	5.11	7.50	32.70	51.04	3.65
IV.	58.60	1.97	3.49	14.08	20.48	1.38	4.76	8.43	34.00	49.47	3.34
V.	59.13	2.14	3.58	13.95	19.71	1.49	5.23	8.75	34.13	48.25	3.64
VI.	57.32	1.85	3.41	13.92	22.39	1.11	4.33	8.00	32.61	52.46	2.60
VII.	56.27	2.12	3.36	13.52	23.40	1.33	4.84	7.69	30.91	53.51	3.05
VIII.	54.98	1.93	2.52	14.12	24.08	1.37	4.29	7.81	31.37	53.48	3.05
IX.	57.19	2.06	3.17	12.99	23.38	1.21	4.81	7.43	30.34	54.60	2.82
X.	55.91	2.28	3.64	13.49	23.26	1.42	5.18	8.25	30.61	52.75	3.21
XI.	56.14	2.23	3.37	14.15	22.55	1.56	5.08	7.69	32.26	51.41	3.55
XII.	55.79	2.28	3.73	14.11	22.69	1.49	5.15	8.44	31.91	51.16	3.34
XIII.	60.18	2.09	3.06	12.83	20.56	1.28	5.25	7.69	32.23	51.61	3.22
XIV.	58.38	2.06	2.91	13.20	22.29	1.16	4.96	7.00	31.72	53.54	2.78
XV.	59.85	2.22	3.26	12.30	21.14	1.23	5.54	8.12	30.65	52.62	3.07
XVI.	59.36	2.24	3.68	12.65	20.59	1.49	5.51	9.06	31.12	50.64	3.67
XVII.	57.14	2.12	3.40	13.58	22.39	1.37	4.96	7.94	31.69	52.20	3.21
XVIII.	59.91	2.07	2.78	12.50	21.33	1.41	5.06	6.94	31.18	53.29	3.53
XIX.	59.77	2.23	3.14	12.74	20.84	1.28	5.54	7.81	31.67	51.80	3.18
XX.	58.59	2.00	2.95	12.54	22.50	1.42	4.84	7.12	30.28	54.32	3.44
XXI.	56.03	1.99	3.27	14.05	23.03	1.63	4.52	7.44	31.95	52.37	3.71
Average.	57.31	2.08	3.23	13.38	22.64	1.36	4.92	7.79	31.75	52.36	3.18

ALBUMINOID AND NON-ALBUMINOID NITROGEN.

The following table shows the variation in per cent of albuminoid and non-albuminoid nitrogen, together with the average for the plats:

PLAT.	Total nitrogen	Albuminoid nitrogen.	Amide nitrogen	Per cent of total nitrogrn in amide form.
I.	1.11	.95	.16	14.41
II.	1.20	.95	.25	20.83
III.	1.20	.95	.25	20.83
IV.	1.35	1.17	.18	13.33
V.	1.40	1.01	.39	27.25
VI.	1.28	1.20	.08	6.25
VII.	1.23	1.06	.17	13.82
VIII.	1.25	1.22	.03	2.40
IX.	1.19	1.14	.05	4.20
X.	1.29	1.09	.20	15.60
XI.	1.23	1.18	.05	3.99
XII.	1.35	.90	.45	33.33
XIII.	1.23	1.06	.17	13.82
XIV.	1.12	1.06	.06	5.35
XV.	1.30	.92	.38	29.23
XVI.	1.45	1.03	.42	28.98
XVII.	1.27	1.27	.00	.00
XVIII.	1.11	1.09	.02	1.80
XIX.	1.25	1.20	.05	4.00
XX.	1.14	.98	.16	14.03
XXI.	1.19	1.01	.18	15.12
Average	1.24	1.07	.17	13.71

SUGARS AND STARCH.

The per cent of sugars and starch for the dry substance of the hays from the several plats, are given in the following table:

PLAT.	Invert sugar.	Sucrose.	Starch.	Per cent of nitrogen free extract, as sugars and starch.
I	2.40	5.88	21.20	53.05
II	2.76	7.20	19.19	54.74
III	3.92	5.80	19.00	56.27
IV	3.60	7.60	18.12	59.27
V	2.82	7.04	19.22	61.81
VI	3.60	6.36	22.61	62.08
VII	2.80	7.48	17.55	46.40
VIII	2.32	6.40	20.33	54.31
IX	2.48	7.00	22.04	63.22
X	2.40	5.80	20.29	54.01
XI	3.16	4.72	18.88	52.05
XII	3.20	5.48	19.00	54.10
XIII	5.00	7.32	18.96	60.61
XIV	3.56	5.36	20.52	54.98
XV	3.72	5.96	18.67	52.73
XVI	3.60	5.40	19.95	57.17
XVII	3.44	5.56	20.63	56.76
XVIII	3.20	6.20	17.78	51.00
XIX	3.04	4.68	19.45	52.46
XX	2.96	6.00	19.72	52.79
XXI	3.80	7.28	19.00	57.36
Average	3.23	6.21	19.72	55.69

DIGESTIBILITY.

The digestion coëfficient for the albuminoids of each sample of hay is given below:

PLATS.	Crude Albuminoids Nx 6.25.	True albuminoids.	Albuminoids undigested.	Per cent crude albuminoids digested.	Per cent true albuminoids digested.
I	6.94	5.92	3.75	45.96	36.65
II	7.50	5.92	3.37	55.06	43.07
III	7.50	5.94	3.75	50.00	36.86
IV	8.43	7.31	3.87	54.09	47.06
V	8.75	6.31	2.94	66.40	53.40
VI	8.00	7.50	3.87	51.62	49.73
VII	7.69	6.63	3.87	49.67	41.63
VIII	7.81	7.62	3.56	54.41	50.28
IX	7.43	7.12	3.56	52.08	50.00
X	8.25	6.81	3.25	60.60	52.26
XI	7.69	7.17	4.06	47.20	43.37
XII	8.44	5.63	3.87	54.14	31.26
XIII	7.69	6.63	3.38	56.01	49.03
XIV	7.00	6.63	3.37	51.85	49.17
XV	8.12	5.75	3.25	59.97	43.47
XVI	9.06	6.44	3.75	58.60	41.77
XVII	7.94	7.94	4.44	43.91	44.08
XVIII	6.94	6.81	3.38	48.70	36.68
XIX	7.81	7.50	3.75	50.70	50.00
XX	7.12	6.12	3.25	54.35	46.89
XXI	7.44	6.31	3.37	54.70	46.59
Average	7.79	6.19	3.62	52.49	43.88

ASH ANALYSES.

Partial analyses of the ash from sixteen of the timothies were made, and the results are tabulated below:

PLAT.	Ash.	Phosphoric acid. P_2O_5	Potash. K_2O	Soda. Na_2O	Lime. CaO	Magnesia. MgO
I	4.33	5.52	33.04	10.76	8.56	2.20
II	4.09	3.73	27.56	6.99	9.92	1.96
III	5.11	5.00	32.32	2.56	7.52	1.96
IV	4.76	6.44	33.77	5.36	8.24	1.85
V	5.23	7.40	35.21	3.47	......	1.71
VI	4.33	4.96	32.88	4.48	8.64	2.53
VII	4.84	8.46	34.16	8.01	14.00	1.84
XIII	5.25	5.12	31.96	2.64	7.44	1.87
XIV	4.96	4.34	36.08	7.96	7.92	1.96
XV	5.54	6.95	30.72	5.28	10.00	2.24
XVI	5.51	5.63	34.72	5.58	8.80	.95
XVII	4.96	......	32.96	3.48	9.84	1.76
XVIII	5.06	6.55	34.96	5.28	8.56	1.85
XIX	5.54	6.14	29.96	......	7.76	2.04
XX	4.84	6.67	39.92	4.72	7.36	2.08
XXI	4.52	5.99	36.87	5.24	6.96	2.12

ASH CONSTITUENTS, CALCULATED IN DRY SUBSTANCE OF HAYS.

PLAT.	Phosphoric acid. P_2O_5	Potash. K_2O	Soda. Na_2O	Lime. CaO	Magnesia. MgO	Nitrogen.
I	.238	1.431	.466	.371	.095	1.11
II	.153	1.127	.286	.406	.080	1.20
III	.255	1.651	.131	.384	.100	1.20
IV	.316	1.607	.255	.403	.088	1.35
V	.387	1.841	.181	......	.089	1.40
VI	.215	1.424	.194	.374	.109	1.28
VII	.409	1.653	.388	.677	.089	1.23
XIII	.269	1.678	.138	.390	.097	1.23
XIV	.215	1.789	.395	.323	.097	1.12
XV	.384	1.702	.292	.554	.125	1.30
XVI	.310	1.913	.307	.485	.052	1.45
XVII	......	1.635	.173	.488	.087	1.27
XVIII	.331	1.769	.267	.433	.105	1.11
XIX	.340	1.660	......	.430	.113	1.25
XX	.323	1.448	.228	.356	.100	1.14
XXI	.271	1.666	.237	.314	.096	1.19

The results obtained from the experiments of this year, to determine the influence of fertilizers upon the composition of timothy and clover, show us nothing as to the possible influence of fertilizers. The soil upon which we are experimenting, it seems, is sufficiently rich to produce good crops, under favorable conditions, without the use of fertilizers for immediate effect. The timothy hay grown upon the unfertilized plat, XV, was richer in albuminoids and nitrogen free extract than was the average for the entire plats, although many of them were heavily fertilized. The greatest variation in the composition of the timothies, differently fertilized, is far less than the variation in the chemical composition of timothy for two successive years of growth upon the same plats, under like conditions and without fertilizers, so far as field culture furnishes this. We hope to be able to continue the experiment one year more, in order to study the after effect of fertilizers in such soils.

Notwithstanding the failure of the experiment to show what it was planned to do, much information can be gathered from the results of the chemical examinations, which have been quite complete.

The range in the digestibility of the albuminoids of the clover, from 38 to 72 per cent, and for the timothy from 43 to 66 per cent, shows a greater variation than we had expected, but we cannot attribute this difference to the effect of fertilizers, for we find those plats intended to be duplicates showing differences little less than those differently treated.

The sugars and starch of timothy constitute a considerable portion of the nitrogen free extract, while of clover the per cent of starch is less than one-half the amount in timothy, and the same is true of that portion determined as sucrose, and these constitute little more than a third of the nitrogen free extract. These variations are shown by the following:

RED CLOVER.

	Invert sugar.	Sucrose.	Starch.	Per cent of nitrogen free extract as sugars and starch.
Minimum	2.60	.88	5.58	27.72
Maximum	5.60	4.40	13.90	43.88
Average	3.88	2.48	9.38	35.40

TIMOTHY.

	Invert sugar.	Sucrose.	Starch.	Per cent of nitrogen free extract as sugars and starch.
Minimum	2.40	4.68	17.55	46.40
Maximum	5.00	7.60	22.61	63.22
Average	3.23	6.21	19.72	55.69

The application of potash to the soil did not increase the per cent of sugars and starch in our experiments with timothy and clover, nor can we trace any exact relation between the phosphates and amount of albuminoids in the hays.

FERTILIZING MATTERS IN 1,000 POUNDS OF VARIOUS FARM PRODUCTS.

From the data furnished in this report we calculate the approximate amounts of the various fertilizing ingredients removed from the soil by 1,000 pounds of some of our farm products, and the principal feeding stuffs, as determined for these products at this Station. The amount of dry matter, crude ash and the phosphoric acid, potash and nitrogen are given in the following table:

TABLE SHOWING POUNDS OF FERTILIZING MATTER IN 1,000 LBS. OF FARM PRODUCTS AND FEEDS.

SUBSTANCES.	Dry matter.	Ash.	Phosphoric acid. $P_2 O_5$	Potash. $K_2 O$	Nitrogen.
Medium Red Clover	846	53.9	3.9	8.8	20.3
Red Clover (average 6)	846	54.9	2.5	13.1	19.3
Alsike Clover	846	72.5	3.8	24.2	21.8
Lucerne	846	73.7	4.6	13.9	20.3
Orchard Grass	846	53.5	4.1	20.1	11.1
Meadow Fescue	846	51.7	3.6	14.4	12.8
Tall Meadow Oat	846	46.4	3.2	17.5	11.6
Timothy (average 2)	846	40.6	2.3	11.7	8.7
Timothy (average 16)	846	42.2	2.5	14.4	10.5
Fodder Corn	179	11.0	0.5	2.6	2.4
Corn Fodder	700	50.3	0.9	6.1	6.5
Corncobs	900	17.8	0.1	8.1	2.3
Wheat Straw	821	41.6	1.0	5.2	4.8
Oat Straw	837	48.5	0.6	13.5	3.8
Beets	10	2.0	0.1	0.8	0.3
Oats	890	31.5	13.1	3.9	17.8
Wheat	867	15.7	7.2	3.7	18.9
Corn	844	14.1	7.7	3.6	13.9
Flour	868	3.7	1.9	1.2	14.6
Wheat Bran	850	50.4	25.5	8.3	22.5
Wheat Middlings	860	33.8	16.9	6.2	20.7
Shipstuff	860	49.5	20.2	9.7	24.1
Cottonseed Meal	917	67.3	29.3	19.6	72.1
Linseed Meal	893	51.4	18.7	11.3	52.4

AVERAGE COMPOSITION OF FODDERS.

During the past six years a large number of feeding-stuffs have been analyzed, the results of which are scattered through the several reports. That the results of these analyses may be more easy of access, and that general averages and variations may be shown, we give, in condensed form, a table showing the average composition, as determined from the number of analyses made at this Station, of all those products which are of general interest.

In this table the maximum and minimum are given, together with the averages. The grasses which were analyzed in their fresh state have also had the analyses calculated to the average water composition of hay. A large number of analyses of no special interest, as well as many partial analyses, are not included in these tables.

GRASSES, ETC.	No. analysis.	DRY MATTER.			Ash.	ALBUMINOIDS. Nx 6.25.			CRUDE FIBER.			NITROGEN FREE EXTRACT.			FAT (ETHER EXTRACT).		
		Minimum.	Maximum.	Average.		Minimum.	Maximum.	Average.	Minimum.	Maximum.	Average.	Minimum.	Maximum.	Average.	Minimum.	Maximum.	Average.
Lucerne in bloom	4	24.99	43.27	32.54	2.95	4.07	7.69	5.91	8.67	14.81	10.51	9.45	16.47	12.02	.64	1.73	1.15
Timothy, in full bloom	21	39.14	45.02	42.69	2.08	2.52	3.68	3.23	12.18	14.49	13.38	19.71	24.08	22.61	1.11	1.63	1.36
Timothy, seed formed	3	51.22	53.02	51.86	2.25	3.14	3.38	3.28	16.57	19.35	18.16	25.03	27.74	26.72	1.32	1.60	1.45
Red clover, in bloom	21	28.85	34.17	31.66	2.05	3.80	5.63	4.51	8.46	11.31	9.77	12.64	15.80	14.03	.97	1.76	1.30
Orchard grass	3	23.75	35.00	28.52	2.14	2.40	2.97	2.65	7.60	12.54	10.23	9.23	16.73	12.39	1.14	1.35	1.21

GREEN FODDERS.	No. analysis.	DRY MATTER.			Ash.	ALBUMINOIDS, Nx 6.25.			CRUDE FIBER.			NITROGEN FREE EXTRACT.			FAT (ETHER EXTRACT).		
		Minimum.	Maximum.	Average.		Minimum.	Maximum.	Average.	Minimum.	Maximum.	Average.	Minimum.	Maximum.	Average.	Minimum.	Maximum.	Average.
Sorghum	2	15.42	16.57	16.00	.77	.90	1.04	.97	4.71	5.76	5.23	8.36	8.61	8.58	.38	.47	.43
Amber cane	3	13.62	24.96	17.56	.74	1.03	1.42	1.17	5.45	6.56	5.94	5.34	17.03	9.32	.38	.40	.39
Fodder corn	10	12.57	29.26	19.34	.99	.94	2.47	1.54	4.47	11.41	6.10	6.16	12.72	10.07	.34	.87	.58
Ensilage, fodder corn	6	13.02	21.39	15.86	.96	.72	1.60	1.00	2.97	7.10	5.14	5.90	10.22	7.92	.52	1.15	.84
Ensilage, corn fodder	2	39.28	42.14	40.71	1.72	3.54	3.71	3.62	7.83	8.39	8.11	23.90	25.69	24.80	2.36	2.56	2.46
Ensilage, Hungarian	1	.....	......	39.49	2.75	....	....	3.30	....	......	13.60	......	......	17.51	....	....	2.33
Cow pea	2	13.97	17.90	15.94	1.83	3.00	3.25	3.12	2.87	4.09	3.48	5.34	8.46	6.91	.58	.62	.60
Soja hispida	3	30.65	29.59	30.13	2.38	2.20	3.94	3.34	7.93	8.91	8.36	14.24	16.01	13.90	.87	1.55	1.15
Prickly comfrey	3	11.76	21.30	15.64	2.45	1.88	3.69	2.94	2.00	3.19	2.61	5.27	10.42	7.13	.31	.84	.51

ROOTS, TUBERS, ETC.	No. analysis.	DRY MATTER.			Ash.	ALBUMINOIDS, Nx 6.25.			CRUDE FIBER.			NITROGEN FREE EXTRACT.			FAT (ETHER EXTRACT).		
		Minimum.	Maximum.	Average.		Minimum.	Maximum.	Average.	Minimum.	Maximum.	Average.	Minimum.	Maximum.	Average.	Minimum.	Maximum.	Average.
Sweet potatoes	1	......	......	25.62	1.34	....	....	3.56	....	....	2.14	......	......	17.98	....	....	.60
Potatoes	3	19.61	23.80	21.51	.84	2.28	2.50	2.42	.59	.85	.68	15.33	19.91	17 50	.02	.08	.06
Cabbage, outer leaves	1	......	......	10.14	1.35	....	....	1.83	....	....	2.98	......	......	3.51	....	....	.47
Turnips	1	......	......	7.60	.72	....	....	1.25	....	....	1.20	......	......	4.20	....	....	.23
Pumpkins	1	......	......	7.73	.63	....	....	1.11	....	....	1.49	......	......	4.34	....	....	.16
Mangolds	1	......	......	5.59	1.09	....	....	1.03	....	....	1.00	......	......	2.40	....	....	.07
Carrots	1	......	......	8.87	1.00	....	....	1.08	....	....	1.41	......	......	5.09	....	....	.29
Okra	1	......	......	12.59	.74	....	....	1.99	....	....	3.42	......	......	6.04	....	....	.40
Onion	2	......	......	10.74	.45	1.04	1.14	1.09	.59	.71	.65	7.39	9.23	8.31	....	....	.24
Tomatoes	1	......	......	8.74	.73	....	....	1.00	....	....	.70	......	......	5.84	....	....	.47
String beans	1	......	......	16.54	.83	....	....	2.75	....	....	2.58	......	......	10.04	....	....	.34
Apples, sweet	1	......	......	22.70	.46	....	....	.50	....	....	1.37	......	......	19.96	....	....	.41

	No. analyis.	DRY MATTER.			Ash.	ALBUMINOIDS. Nx 6.25.			CRUDE FIBER.			NITROGEN FREE EXTRACT.			FAT (ETHER EXTRACT).		
		Minimum.	Maximum.	Average.		Minimum.	Maximum.	Average.	Minimum.	Maximum.	Average.	Minimum.	Maximum.	Average.	Minimum.	Maximum.	Average.
HAYS.																	
Timothy. in full bloom.....	21	......	......	84.65	4.16	......	......	6.59	......	......	26.88	......	......	44.33	....	....	2.69
Timothy, seed formed......	3	......	......	84.65	3.65	......	......	5.34	......	......	29.65	......	......	43.65	....	....	2.36
Orchard grass..............	3	......	......	84.65	5.00	......	......	......	......	......	......	......	......	......	....	....	.....
Mixed hays.................	9	82.00	90.68	85.20	4.92	4.83	9.25	6.37	31.28	35.89	32.30	26.88	46.88	39.15	2.06	3.26	2.46
Red clover, in bloom	21	......	......	84.65	5.50	......	......	12.05	......	......	25.99	......	......	37.63	....	....	3.48
Alsike clover................	1	......	......	89.51	6.26	......	......	9.87	......	......	32.14	......	......	38.16	....	....	3.08
Clover, Rowen.............	2	85.47	85.87	85.67	6.23	10.36	11.80	11.08	28.22	29.38	28.80	35.84	36.88	36.36	3.09	3.31	3.20
STRAWS.																	
Wheat straw...............	1	......	......	82.14	4.16	......	......	2.98	......	......	42.74	......	......	31.04	....	....	1.22
Oat straw..................	1	......	......	83.72	4.83	......	......	2.35	......	......	36.77	......	......	37.97	....	....	1.80
Corn fodder................	3	43.51	60.98	50.99	3.62	2.86	3.51	3.25	15.46	21.72	18.78	20.64	30.78	24.13	1.11	1.30	1.21
Soja bean fodder...........	1	......	......	78.77	8.37	......	......	8.42	......	......	22.34	......	......	38.29	....	....	1.35

	No. analyses.	DRY MATTER.			Ash.	ALBUMINOIDS, N x 6.25.			CRUDE FIBER.			NITROGEN FREE EXTRACT.			FAT (ETHER EXTRACT).		
		Minimum.	Maximum.	Average.		Minimum.	Maximum.	Average.	Minimum.	Maximum.	Average.	Minimum.	Maximum.	Average.	Minimum.	Maximum.	Average.
R N, MEALS, ETC.																	
Corn	7	83.93	93.91	89.46	1.57	8.62	14.56	10.86	1.59	3.25	2.31	65.17	75.50	69.21	3.58	8.14	5.51
Corn meal	18	72.59	91.99	82.92	1.30	7.11	10.86	8.90	.50	2.81	1.74	57.02	73.96	67.16	2.23	5.06	3.82
Wheat, winter	2	86.17	87.20	86.69	1.57	10.61	13.00	11.81	2.45	3.76	3.11	67.40	69.74	68.57	1.63	1.64	1.63
Wheat flour	1	......	......	86.74	.38	......	......	10.50	......	......	1.21	......	.....	73.62	.....	.....	1.03
Oats	3	83.75	89.91	86.80	3.05	10.30	11.63	10.95	10.41	19.37	15.45	50.75	54.97	53.24	4.49	3.38	4.11
Pea meal	1	......	......	87.92	2.61	......	......	21.37	......	.....	11.06	......	.....	52.02	.....	.....	.86
Bean, navy	1	......	......	87.61	3.71	......	......	22.17	......	......	7.21	......	.....	53.14	.....	.....	1.38
BY-PRODUCTS.																	
Wheat bran	10	84.17	90.73	86.29	5.53	13.69	16.05	14.56	7.50	15.50	10.83	40.53	55.62	52.26	1.50	5.86	3.11
Shipstuff	3	84.00	85.90	85.25	5.27	14.96	17.47	16.38	4.77	8.02	6.36	53.43	53.86	52.66	4.09	4.93	4.58
Wheat middlings	3	85.96	90.56	87.59	3.61	12.45	17.99	15.62	3.56	4.70	4.22	57.69	60.83	59.66	4.22	4.88	4.48
Brewers' grains	6	20.59	25.02	23.40	.94	4.44	5.33	4.82	3.05	4.38	3.82	11.06	14.13	12.53	.84	1.44	1.29
Corn feed, starch feed, etc.	5	31.49	36.30	34.60	.21	4.31	7.70	5.96	2.07	4.29	3.41	18.69	24.93	21.41	2.00	4.27	3.51
Corn feed, "dry"	1	......	......	94.00	.72	......	......	16.04	......	......	13.02	......	.....	58.14	.....	.....	6.08
Gluten meal	6	83.50	92.69	89.51	.74	15.03	30.16	21.39	.73	8.59	5.62	51.77	57.96	54.87	4.79	10.33	6.89
Linseed meal	11	87.96	92.12	90.17	5.13	28.73	35.52	31.53	4.68	13.99	11.53	28.22	39.26	34.95	3.23	10.25	7.03
Cottonseed meal	3	81.18	91.55	86.52	7.48	35.21	41.88	38.54	3.45	5.96	4.71	20.94	21.44	21.20	12.32	16.87	14.59

METHODS OF ANALYSES.

The regular method of analysis pursued has been the same as that described by Dr. Babcock,* while the method of digestion given in the Station report for 1885 has been followed. The determination of sugars and starch in feeding stuffs has been made as follows:

SUGARS.

Five grams of substance are brought upon a filter and washed with water until the filtrate amounts to 200 cc. Ten cubic centimeters (0.25 gram substance) of this solution are taken, and the sugar determined by Fehling's solution. This gives the invert sugar, glucose, etc., or water soluble extractive matter capable of reducing copper.

Another portion of the filtrate is heated on the water-bath for one-half hour with a few drops of HCl., then neutralized with sodium carbonate, and the sugar determined by Fehling's solution, as in the previous case. The difference between the two determinations gives the amount from sucrose, or water soluble matter inverted by HCl.

STARCH.

Five grams of the substance are put in a flask of 250 cc. capacity, 150 cc. of distilled water, and four to five cc. of concentrated HCl. added, and the flask closed by a cork carrying a small glass tube about three and one-half feet in length, which acts as a condensor. The flask is then put in a water bath kept at 100° C, for twelve hours, which time seems to be sufficient to invert the starch. The flask is allowed to stand over night; the solution is then filtered off, and the filtrate made alkaline by sodium carbonate, and the washing continued until the filtrate amounts to 200 cc. The sugar is then determined in 10 cc. of the filtrate, by Fehling's solution, and the starch calculated from the sugar, or better, by reading directly from a plotted chart the amount of starch for the permanganate solution required.

The ash from a considerable number of feeding stuffs has been more or less fully analyzed, especially as regards the fertilizing constituents, and the method pursued was as follows:

ASH ANALYSES.

The substance for ash analysis is burned in the same manner as for ash determination in fodder analysis, at low heat, then thoroughly pulverized in an agate mortar and preserved in well-stoppered bottles until wanted for analysis.

SOLUTIONS.

One gram of ash is weighed into a platinum evaporator, and a little water added, then a small glass funnel is inverted in the evaporator and HCl. cautiously added until effervescence ceases, then a few drops of HCl., in excess, and the whole evaporated to dryness. The residue is then moistened with HCl., and water added and heated on water-bath for a few minutes, then filtered through a tarred Gooch crucible. The residue is sand, silica and carbon, dried, weighed, ignited, loss taken as carbon, remainder as sand and silica.

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* Report of the New York Agricultural Experiment Station, 1883, p. 166.

The filtrate is made up to 200 cc. and 50 cc., used in each of the following: A, B and C:

A. SULPHURIC ACID.

Fifty cubic centimeters of the filtrate are made up to 100 cc., or more, heated to boiling, and barium chloride added and then filtered; precipitate is barium sulphate.

ALKALIES.

The filtrate from the above is heated and barium hydrate added in excess, then filtered, washed, to filtrate I cc. ammonia is added, then ammonia carbonate, and heated, then about 0.5 grams oxalic acid added and filtered, washed thoroughly with hot water, filtrate evaporated to dryness, ignited gently to drive off ammonium salts, then dissolved in water and a few drops of HCl. added, and filtered into a tarred evaporator and again brought to dryness, ignited gently at low heat. cooled and weighed as total alkalies.

POTASH.

The above residue is dissolved with water in a porcelain evaporator and platinum chloride added, evaporated on steam bath nearly to dryness, but not enough to drive off the water of crystallization, alcohol (80 per cent) added, and allowed to stand for fifteen minutes, alcohol then decanted and precipitate repeatedly washed with alcohol, then the precipitate is brought upon a tarred Gooch crucible, washed with a little ether and dried at 100 C. for thirty minutes and weighed.

SODA.

Soda is determined by difference between potash and total alkalies.

B. IRON AND ALUMINA.

Fifty cubic centimeters of the original solution were made alkaline withammonia then acetic acid added in excess. The precipitate may be feric and alumnic phosphate, but is weighed as $Fe_2 (P O_4)_2$.

LIME.

The filtrate from last is heated and ammonium oxalate added, then allowed to stand in a warm place for a few hours and filtered, washed, dried, ignited intensely and weighed directly as $Ca O$.

MAGNESIA.

The last filtrate is made alkaline with ammonia, and then sodium phosphate added and allowed to stand, then filtered, washed, dried, ignited and weighed as $Mg_2 P_2 O_7$.

C. PHOSPHORIC ACID.

Fifty cubic centimeters of the original solution are taken, heated and about 15 grams of ammonium nitrate added, then for every decigram of $P_2 O_5$ 50 cc. of molybdic solution are added, kept for one hour at about 65 C., then a few cc. of the clear solution are tested in a test tube by adding fresh molybdic solution and heating over flame; if no precipitate forms, it is filtered and washed with ammonium nitrate solution. The precipitate is dissolved on the filter with ammonia and hot water, filtrate nearly neutralized with HCl, allowed to cool, then magnesia mixture slowly added, stirring constantly. After 15 minutes 25 cc. ammonia are added and allowed to stand two hours or more, then filtered through a tarred Gooch crucible, washed with dilute ammonia, dried, ignited intensely and weighed as $Mg_2 P_2 O_7$.

SOME EDIBLE FUNGI.

MUSHROOMS — PUFF BALLS.

The general impression has prevailed that the nutritive value of the various fungi used as food was about equal to that of meat, but a recent article by a German chemist,* C. T. Morner, states that this is an erroneous impression. Morner says: "The total nitrogen that these fungi contain varies between 2 and 3.64 per cent in the dry material. Forty-one per cent of the total nitrogen is useful in alimentation; all the rest belongs to non-assimilable bodies. Notwithstanding the relatively high figures, fungi constitute a very mediocre food, since the figures relate to dry material and fungi contain enormous quantities of water."

Among the tables presented is one giving the amount of the several fungi that would be required to equal a pound of beef:

Mushrooms	9	pounds.
Lactarius deliciosus	24	"
Chanterelle	41	"
Morel	15	"
Polyporus ovinus	67	"

So completely were the statements of this article at variance with the common opinion as to the nutritive value of fungi that I gathered and analyzed two of the most common in this vicinity during the early autumn.

MUSHROOMS.

A quantity of mushrooms (Agaracus campestris), growing in a pasture near the Station, was gathered and subjected to an analysis, and the digestibility of the albuminoids determined by the pepsin method. The results were as follows:

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* L'Engrais; also Scientific American Supplement, June 11, 1887.

	Fresh substance.	Water free.
Water	89.15	.....
Ash	.85	7.80
Albuminoids	6.08	56.00
Crude fiber	.76	7.05
Nitrogen-free extract	2.27	21.83
Fat (ether extract)	.79	7.32
Total nitrogen		8.96
Albuminoids digested		84.50

The total nitrogen found in the dry substance was about 2.5 times as great as the highest figures given by the German chemist, while the digestibility places it among the exceptionally rich nitrogenous foods. The specimens examined were not particularly good ones. I have not been able to secure either morels or boletus for examination, although not usually uncommon in the vicinity of Geneva.

PUFF-BALL.

September 4 we found portions of a large puff-ball which had been broken but a short time, probably by parties who did not know or appreciate the value of the table delicacy they had so fully scattered. Considerable of the broken fragments were gathered together and taken for analysis. This specimen was in fine edible maturity, and we hoped to be able to find another fresh one. In our search Dr. Babcock found a fine large specimen of *Lycoperdon giganteum* which I have examined. The following measurements were taken, and are of interest, taken in connection with the analysis.

Greatest diameter	12.5 inches.
Height	7.5 "
Horizontal circumference	37.25 "
Vertical circumference	33.5 "
Weight	2864 grams=6.35 lbs.

The puff-ball was kept until the following morning before examination, when it was found to have lost 5.93 per cent by weight. A slice passing through the center was taken for analysis. This contained 92.18 per cent of water.

free use of fore-legs and a general weakness, and they would only move about when forced to do so. The mice with backs arched remained quiet, with nose drawn down between the fore-legs and resting the foreheads upon the bottom of their cage. There was no vomiting or purging, and they gradually grew better and finally recovered.

On receiving the cream I at once forwarded a portion of it to Dr. V. C. Vaughan, of Michigan University, Ann Arbor, Mich., who was the first to thoroughly investigate the nature of these poisonous products in cheese and in cream, and who gave to them the name tyrotoxicon. Dr. Vaughan kindly examined this, and under date of July 11, wrote me as follows:

> "I will give you the results of the analysis of the cream which you had the kindness to send me. I tested for tyrotoxicon only, supposing that you had examined it for other poisons.
>
> "Some distilled water was added to the contents of the bottle, and the whole was filtered. The filtrate gave the reaction with sulphuric and carbolic acids very distinctly; but, as you know, this reaction may be due to tyrotoxicon (diazobenzol) or to nitrates or nitrites. The filtrate was then neutralized with sodium carbonate and agitated with an equal volume of ether. The ether was removed and allowed to evaporate spontaneously. To this residue a little water and a few drops of nitric acid were added, and then an equal volume of a saturated solution of potassium hydrate, and the whole heated on the water-bath, when the beautiful plates of diazobenzol (tyrotoxicon) potassium hydrate were formed.
>
> "After having obtained these crystals, I was unavoidably called away from my work for a few hours, and on my return I found that the crystals had all decomposed. So I did not have the opportunity of making other and confirmatory tests; but I should have no hesitancy, from the tests which I did make, in saying that diazobenzol (tyrotoxicon) was present."

This confirmed the result of my own examination and conclusively demonstrated that tyrotoxicon was present, and, with the experiments made upon mice, showed the cause of the sickness to be due to this product.

At a later date Dr. Vaughan wrote me as follows:

> "The action of the poison on the mice, as observed by you, is very interesting. I have obtained exactly the same symptoms with the artificially prepared diazobenzol on guinea pigs and frogs. In these animals there was neither vomiting nor purging, while the same substance induced vomiting in cats and dogs."

The method by which the milk was furnished for the occasion, and the mixing together that from so many different sources and of different ages and then allowing them to stand for some hours, would be most favorable to the development of these decomposition products and was the probable source of trouble. Had fresh milk been used, or that from one source, there would probably have been no such serious effects resulting from eating of the cream.

It would seem as if danger of ice-cream poisoning comes principally from picnic or contributed milk, and not often from fresh or purchased milk, which is presumably of one age.

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It would seem as if danger of ice-cream poisoning comes principally from picnic or contributed milk, and not often from fresh or purchased milk, which is presumably of one age.

READING OF THE AIR THERMOMETERS.

1887.	January.			February.			March.			April.			May.			June.		
	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.
1	20.	19.5	13.	8.5	11.	7.	17.	20.7	24.7	27.	40.	36.	49.	61.5	60.5	53.7	62.	68.5
2	2.2	4.2	2.7	9.	22.	29.	32.	46.	40.	27.5	38.7	35.	53.7	74.	74.5	66.	64.	66.7
3	0.	12.	13.	32	33.2	27.	22.7	26.	23.	36.	51.5	59.	62.	78.5	73.	58.	67.2	65.2
4	5.	13.	16.2	18.	17.7	14.	23.	28.	21.	49.	62.	46.	56.2	62.5	61.2	63.	73.	73.
5	17.5	22.	23.2	3.5	16.5	19.5	10.	22.	20.	22.	25.	23.5	49.5	64.	64.5	61.	72.2	68.
6	20.	24.	21.	31.	35.	34.	33.5	35.	37.	24.5	34.	35	59.	72.	71.2	61.	65.5	64.5
7	14.	15.2	8.	22.	21.5	27.5	40.5	45.5	36.5	31.5	39.5	33.	56.	69.	70.2	62.7	71.	71.5
8	0.	13.7	8.2	36.	40.2	41.	30.	34.7	33.5	29.2	49.5	51.	60.	72.5	67.2	63.7	72.5	76.
9	6.	13.2	18.	28.5	29.	29.	35.2	46.7	41.	38.	67.	63.	59.5	75.5	69.5	68.	61.	65.7
10	16.	15.	15.	27.5	42.	40.	32.2	32.	29.	62.7	72.8	67.2	57.2	73.5	76.2	58.	73.	69.7
11	7.7	15.	20.5	31.7	28.7	18.5	18.5	22.5	24.5	63.	57.	43.	57.	67.5	64.7	59.	72.5	73.2
12	20 5	30.5	28.2	10.7	14.	13.	22.	31.5	31.5	36.	41.	39.7	49.7	68.5	65.	59.7	76.	73.5
13	18.	18.7	20.	10.	12.5	10.	27.	38.	39.	37.	47.5	43.2	51.7	59.	58.	63.	78.5	74.
14	35.2	41.2	34.5	16.7	29.	30.2	27.	24.	17.2	41.	46.5	48.5	47.	65.	64.7	65.5	74.5	70.
15	25.2	20.	19.5	35.	38.	36.2	14.	18.5	19.	43.2	46.2	48.	48.2	72.6	73.5	58.2	76.	78.5
16	19.	20.	19.2	33.	34.5	34.2	15.5	18.5	18.5	46.7	40.	38.5	54.5	74.7	72.2	72.	84.7	83.
17	34.	36.2	23.7	28.5	29.	26.5	21.	23.2	19.5	29.	37.	34.	63.	74.7	71.7	62.	64.7	63.7
18	9.	.7	-2.	32.	34.5	38.7	23.7	27.	26.	29.5	30.5	26.7	55.	70.	65.	58.	70.	64.
19	4.	14.	20.5	32.	31.	29.	27.	30.5	30.	28.	38.2	40.5	53.5	71.	68.	62.7	66.	70.
20	26.2	35.2	38.5	22.	24.6	24.2	30.	35.2	32.	35.7	51.5	50.5	56.7	81.	76.2	62.5	76.2	75.5
21	30.7	27.	21.2	18.	27.5	25.	30.	37.2	37.2	40.5	55.5	47.	64.	83.	76.7	71.	82.5	75.2
22	36.	41.7	43.2	29.5	34.7	27.5	30.5	31.2	31.	38.7	61.	51.2	62.	83.7	82.	63.	69.	71.
23	43.2	47.	45.2	23.2	29.	34.	18.	23.2	24.	47.	57.7	51.	67.5	82.	76.5	63.7	73.7	65.2
24	39.5	28.7	29.2	37.7	32.	25.5	25.	42.2	41.4	40.	46.2	42.	67.5	79.5	65.5	59.7	64.	60.5
25	25.2	39.5	43.	13.	19.5	20.	23.7	25.	26.2	43.	52.2	50.7	63.7	75.2	67.2	59 5	71.	69.
26	19.	12.5	8.	26.	27.	35.	18.7	23.7	24.	42.	51.	44.5	58.5	64.	55.5	59.	69.	68.5
27	1.	13.	21.5	22.2	22.5	15.	22.2	26.7	33.5	39.2	50.	47.5	51.5	56.5	58.	58.5	72.2	68.5
28	29.	35.2	38.5	10.	15.	15.5	36.	30.	25.	40.5	59.	50.	50.2	51.7	54.	61.	78.	76.7
29	37.2	37.	32.2				15.7	18.7	15.2	46.	42.2	38.	54.5	67.2	67.	65.7	83.5	82.
30	26.7	35.2	33.				14.7	25.2	25.	39.5	50.7	51.2	54.5	73.5	73.2	69.7	88.	81.5
31	9.5	13.	8.				17.7	31.2	33.				57.	71.2	67.7			

1887.	July.			August.			September.			October.			November.			December.		
	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.
1	69.2	90.	88.5	68.	84.	81.2	53.	73.2	70.	60.	66.	62.5	28.	38.2	29.5	—.5	17.	12.
2	78.5	92.7	86.5	73.	84.	79.	59.	67.	67.7	55.	58.	57.	25.2	54.	51 5	19.5	33.	35.
3	77.	92.	87,	67.5	85.7	84.2	55.	59.7	59.	55.	65.	59.	43.	50.5	45.	35.7	41.	36.
4	77.5	91.	86.	71.5	85.	81.5	51.2	70.5	67.5	48.	49.7	49.	54.	49.	35.5	41.7	44.2	44.
5	70.2	84.7	80.2	69.5	78.2	78.5	56.5	75.5	73.7	48.5	49.5	51.	29.	32.7	34.	37.	33.7	31.7
6	73.7	83.2	83.	67.	73.	71.	61.	65.2	75.	43.7	52.5	54.5	30.	55.7	46.	29.	39.2	33.
7	71.5	83.5	84.	59.	65.7	63.7	69.	79.5	67.5	51.	58.	55.	33.7	66.	51.5	30.	37.2	38.
8	76.	88.5	86.5	55.5	71.7	72.5	52.7	62.7	60.	51.	70.	66.	44.5	43.	32 5	35.7	37.	31.
9	73.	74.7	72.	62.	79.	81.	50.5	66.	64.	59.	69.	63.7	20.	38.	44.	30.2	37.	38.
10	67.2	66.	62.2	68.	81.	79.	55.	52.2	52.	62.7	66.	51.	40.7	45.	36.5	38.2	41.5	46.
11	64.	74.5	79.	70.	73.	78.	41.7	59.	60.	42.7	46.	44.	30	31.5	30.	47.5	51.	51.5
12	70.	85.7	84.2	67.	74.	69.	57.5	64.5	64.7	38.	42.5	42.5	31.7	34.5	34.5	37.2	34.	31.
13	72.2	88.	85.	57.7	68.	65.2	62.	68.2	71.	45.	52.5	46.	33.	36.5	35.	34.	39.5	33.
14	68.	71.5	71.2	55.5	72.2	71.2	64.	70.5	64.5	38.5	43.	37.	36.5	44.2	43.7	33.	41.	36.
15	65.5	70.2	71.	63.7	76.	74.5	58.2	70.7	57.	35.	49.	42.	40.2	40.5	36.7	32.5	33.3	34.
16	80.5	93.	88.	64.5	74.7	74.2	48.	53.7	50.	37.	57.	49.	35.	40.	37.5	24.	28.	24.5
17	72.2	75.5	82.	59.2	78.	75.	40.5	59.	58.7	45.	65.	59.	41.7	44.	38.	21.5	29.5	31.
18	66.2	69.	71.2	62.7	69.	73.	48.	68.	66.	49.5	51.5	47.	33.	40.	34.	29.	30.	30.
19	65.7	80.	80.7	64.7	72.	66.2	54.	75.	63.5	40 5	54.5	47.7	35.	39.	36.	28.5	32.	21.
20	69.	80.	76.	55.	71.	69.5	46.	60.5	59.2	41.	57.	53.	29.	28.2	26.	29.5	26.6	27.
21	70.	80.2	69.5	60.5	74.	61.2	53.5	77.	75.	48.	47.	37.	31.	31.	27.7	29.6	28.	29.
22	73.7	83.	70.5	63.	66.	67.	56.5	59.	54.	34.5	38.	36.5	24.	35.7	29.5	16.	18.2	20.2
23	66.5	74.2	72.2	64.	67.7	65.2	46.	46.2	43.	31.7	39.	46	41.	45.	38.	21.	24.	23.
24	66.2	79.	77.5	60.2	69.5	64.	42.7	44.2	44.7	46.	42.	40.	29.	30.9	32	23.	27.	22.
25	70 5	72.	72.2	54.7	62.5	60.5	42.7	50.	45.2	35.	41.2	31.	44.2	46.	44.7	22.	23.5	23.
26	68.5	77.7	78.5	53.5	60.7	60	40.7	55.	51.2	24.	39.5	37.	47.7	54.7	56 7	22.	28	26.5
27	67.5	83.	82.2	52.	66.	60.5	41.7	58.7	59.	38.	48.	46.	51.2	65.	61.7	16.5	29.2	...
28	71.	86.	85.	55.	62.2	61.7	54.	65.	58.	32.	49.5	45.	42.5	28.2	22.	33.	35.	24.
29	68.	77.	76.	52.7	69.7	67.5	56.5	62.7	62.2	41.	51.5	33.	16.	24.5	20.5	12.	13.	11.
30	69.2	84.	89.	57.2	71.5	67.	60.	69.5	67.	27.	27.5	26.	22.	22.	14.2	11.	12.	10.5
31	72.5	84.2	76.7	54.	72.2	70.				25.	45.7	37.				14.	12.	21.

READING OF THE MAXIMA AND MINIMA THERMOMETERS, 7 A. M.

1887.	JANUARY.		FEBRUARY.		MARCH.		APRIL.		MAY.		JUNE.		JULY.		AUGUST.		SEPT'MB'R.		OCTOBER.		NOVEMB'R.		DECEMB'R.	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
1....	29.	13.	14.5	6.5	17.	8.7	36.7	17.2	55.	38.	73.	52.7	91.	62.5	87.	61.	74.2	47.7	76.	58.	47.7	24.	19.5	—2.
2....	21.	1.	13.	4.	32.1	16.	43.	22.5	63.7	47.	69.7	53.	93.7	69.	86.7	76.7	75.7	58.5	69.5	53.	39.5	22.7	20.	—3.
3....	6.	—1.5	32.2	7.	51.7	21.2	40.5	27.	79.5	53.	71.	54.	95.5	67.5	86.	62.	71.	52.	64.	49.	62.	25.	36.	16.
4....	16.2	2.	35.	17.	28.	19.7	64.5	35.	81.2	56.	72.	57.	93.	68.	88.5	67.	71.5	45.	66.	47.5	62.2	24.5	42.2	34.5
5....	18.7	1.7	19.	2.	28.7	8.7	62.	21.5	67.	47.	76.5	55.5	93.2	67.2	86.	68.7	73.5	50.7	51.	46.5	62.	24.2	46.	36.5
6....	26.	12.2	31.	1.	33.5	10.	27.	20.7	71.	49.	74.	59.	85.	67.5	84.	66.2	77.5	56.	55.2	42.5	37.5	27.7	42.7	26.
7....	19.7	13.	36.	18.	44.	33.	39.	23.7	77.	52.	67.	56.7	87.2	68.	74.5	54.	75.7	60.2	56.	43.	59.7	29.	40.7	26.2
8....	18.	—6.	36.	19.	46.2	29.	40.7	22.7	73.	56.2	73.2	59.7	88.2	69.	67.5	46.	80.5	51.5	61.2	46.7	67.5	43.7	40.	29.7
9....	16.5	—3.	54.2	28.5	37.7	27.5	55.	29.	75.2	55.	76.7	72.5	91.	65.	75.5	55.	65.5	44.	78.5	46.5	45,	18.	37.	28.
10....	21.3	3.	31.2	22.	48.2	32.	69.5	37.7	78.2	54.	70.	51.	90.	64.5	83.2	62.	68.	50.	70.	58.	45.	19.	42.	29.
11....	18.	6.	45.	26.5	33.	17.5	75.7	51.5	79.	54.	75.7	50.7	70.	58.7	81.5	68.2	55.5	39.	67.7	41.7	44.7	29.7	53.5	37.7
12....	24.	—1.	31.5	10.	26.	13.	65.	35.	69.	43.7	76.	50.	80.	61.	80.	66.	64.2	41.2	50.2	35.	32.2	31.7	54.7	31.7
13....	31.	17.	15.7	7.	34.	19.	45.5	35.	70.	45.	78.2	52.7	88.7	68.2	74.5	50.2	66.	56.7	46.5	37.	35.	30.5	34.	31.
14....	35.2	15.5	16.7	6.	42.	26.	53.2	34.	61.	37.5	80.	60.5	90.	63.2	74.5	49.	74.	61.	56.5	36.	41.2	32.	43.	28.
15....	41.	24.5	35.	11.5	28.5	12.6	53.2	38.7	68.5	42.	75.	47.7	75.	60.	77.	55.	78.5	56.	45.	32.5	48.2	31.	45.	30.
16....	27.	18.	38.2	33.	20.	13.	55.	40.5	76.	46.2	84.	58.	81.5	64.	77.7	62.2	74.	44.2	51.	32.5	42.7	34.	37.	23.
17....	34.7	17.7	37.2	28.	22.	14.	47.	28.5	79.5	54.	89.2	61.5	98.	70.5	77.	54.7	57.	37.7	59.5	37.	48.	34.5	31.	20.5
18....	37.2	7.7	32.	24.2	24.5	17.2	10.2	26.5	77.	53.2	68.5	53.5	88.	66.	80.	59.	62.7	40.	68.5	44.2	46.2	32.2	32.	29.
19....	22.5	—8.	41.	24.7	28.7	20.7	33.2	17.7	71.2	45.	73.	55.5	72.5	61.2	75,1	61.7	72.	47.5	56.	38,	42,7	31.7	32.	28.5
20....	26.7	2.2	32.7	21.	30,7	20.	45.	27.7	77.	48.2	76.	57.5	83.2	65.	74.5	51.	75.5	45.	57.5	36.	40.2	28.5	32.	16.
21....	50.5	20.5	27.	11.5	37.	28.5	57.	35.5	85.	53.2	80.	60.5	83.2	68.7	73.5	53.5	65.2	45.	59.	40.5	32.	25.	32.	20.
22....	36.5	5.	31.	17,	43.	29.2	58.	34.	86.	53.7	84.	60.	82.2	67.5	76.	58.5	81.7	53.	49.2	34.	31.7	23.	30.5	14.
23....	46.	16.2	35.2	22.7	32.	17.	64.	38.	88.2	59.5	71.5	55.	83.7	66.2	67.2	62.	60.5	45.7	49.2	28.5	42.	23.	23.	13.
24....	50.7	39.5	37.7	22.	26.2	36.	61.	38.	85,5	62.7	77.	54.5	75.7	61.	71.	56.5	49.7	39.	54.2	30.2	46.5	28.5	26.	20.
25....	40.	20.	40.7	6.7	48.2	18.	48.2	30.	82.5	56.2	69.2	48.7	81.	66.	71.7	50.7	48.	41.	46.5	32.	44.5	34.	30.	13.
26....	48.	18.	26.	11.	36.5	17.5	57.	37.	76.7	51.	73.7	53.	7.75	67.2	64.	48,	57.	39.	43.	21.5	49.5	41.2	25.	20.
27....	19.2	—.7	39.	-4.(?)	26.2	17.3	53.7	29.5	66.2	47.2	70.7	58.3	81.7	60.7	63.	46.5	59.	37.2	43.5	23.	59.2	47.9	28.2	15.5
28....	30.	0.	24.	9.	36.5	20.8	52.2	33.	62.	49.	73.5	51.	85.	64,2	67.	49.7	63.	41.	50.7	29.5	68.	31.7	33.	12.
29....	44.	27.5	....	....	36.7	14.7	60.5	40.	67.2	67.	81.	56.2	89.2	67.2	67.7	46.2	66.	53.	54.5	31.	50.	15.5	37.	11.5
30....	39.	26.	....	....	19.7	10.	46.5	37.	71.2	46.	87.	61.	80.	62.5	72.2	50.2	64.7	56.	54.1	25.7	26.7	15.	13.	9.5
31....	42.7	8.2	....	....	27.7	12.7	....	....	77.	54.	....	....	91.7	69.	73.	47.7	....	....	32.	21.2	....	....	15.	8.

READING OF SOIL THERMOMETERS.

APRIL, 1887.	1 INCH.			2 INCHES.			3 INCHES.			6 INCHES.			9 INCHES.			18 INCHES.		
	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.
1	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
2	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
3	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
4	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
5	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
6	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
7	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
8	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
9	36.5	......	55.5	35.7	......	56.5	35.7	......	55.2	......	......	......	36.7	......	45.	37.	......	38.
10	51.7	65.2	62.	50.	64.5	63.2	49.	59.9	62.	......	......	......	44.2	46.5	61.2	39.7	40.2	41.5
11	54.	57.2	51.5	52.5	56.5	53.5	52.	55.2	53.7	......	......	......	48.	48.5	50.	43.	43.2	43.5
12	......	48.2	45.7	......	47.5	46.7	......	47.	47.	......	......	......	......	44.5	45.5	......	42.2	42.
13	41.	52.5	50.5	41.	49.5	52.2	41.5	48.	52.	......	......	......	41.5	43.2	47.	42.5	42.5	42.5
14	41.	49.	49.5	41.	47.5	50.5	41.5	46.7	50.2	......	......	......	42.5	43.	46.	42.5	42.5	42.5
15	42.2	46.5	48.5	42.2	45.	49.	42.2	44.5	48.7	......	......	......	43.	42.7	44.2	43.	42.5	42.7
16	45.5	42.7	41.	44.	43.5	42.	44.2	43.7	42.5	......	......	......	43.7	43.7	43.	42.7	42.7	42.7
17	33.2	50.	43.5	34.	47.7	45.	35.	45.7	45.7	......	......	......	37.7	40.	43.5	40.5	41.2	41.2
18	32.5	36.	33.7	33.5	36.	34.2	34.5	36.5	35.	......	......	......	38.5	38.	38.	41.	40.5	40.5
19	33.7	49.	45.5	33.7	45.7	46.7	34.2	42.2	46.7	......	......	......	36.7	37.2	42.5	40.	39.5	40.
20	34.	52.	47.7	34.	48.	48.	35.	46.7	48.5	......	......	......	38.2	40.	44.5	40.2	40.	40.7
21	39.	52.7	49.2	38.2	50.7	50.	35.	49.2	50.	......	......	......	40.5	42.5	45.5	41.2	41.2	41.7
22	40.	66.	52.2	39.5	55.	52.5	39.7	53.	52.7	......	......	......	41.7	44.2	48.	42.	42.2	43.
23	45.7	56.7	51.7	45.5	54.5	52.2	45.7	53.	52.2	......	......	......	45.5	46.	48.7	43.7	43.7	44.2
24	41.	53.	48.	41.	51.5	49.2	41.2	50.	49.5	......	......	......	43.5	44.5	46.7	44.2	44.	43.7
25	40.5	54.2	48.5	39.5	52.5	49.	40.	51.2	49.	......	......	......	41.	44.	46.2	43.5	43.2	43.5
26	41.7	54.5	47.7	41.5	54.	48.7	42.	52.	49.	......	......	......	43.7	45.5	47.	43.7	43.7	44.
27	37.5	56.7	49.5	39.	54.7	49.5	39.	52.5	49.5	......	......	......	42.	44.5	47.	44.	53.5	44.
28	41.5	57.2	50.	40.7	54.5	50.2	41.	53.	50.5	......	......	......	43.	45.2	47.7	44.	44.	44.2
29	45.5	46.2	42.	45.5	46.5	43.2	46.	46.5	44.	......	......	......	46.	46.	45.	45.	44.7	44.7
30	40.	52.	48.2	40.	50.	49.7	40.7	48.7	50.7	......	......	......	42.5	43.7	47.2	44.	43.7	44.

READING OF SOIL THERMOMETERS — (*Continued*).

MAY, 1887.	1 INCH.			2 INCHES.			3 INCHES.			6 INCHES.			9 INCHES.			18 INCHES.		
	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.
1	45.5	60.7	56.2	44.	58.	56.7	43.5	55.5	56.7	......	......	......	43.5	46.5	50.2	44.5	44.5	45.
2	52.2	66.2	65.2	49.	62.	64.7	48.7	59.7	63.7	......	......	......	47.5	49.7	54.7	46.	46.2	47.2
3	57.7	74.5	73.2	56.5	71.	73.7	56.	68.	72.5	......	......	......	53.	55.5	60.7	49.	49.	50.2
4	57.	69.7	68.2	57.	67.7	69.2	57.	65.7	69.	......	......	......	56.	56.7	60.7	51.7	51.5	52.2
5	52.5	69.2	67.5	52.2	67.5	68.	52.7	64.	67.2	54.	57.5	63.	54.	55.5	59.7	52.2	52.	52.2
6	58.	72.2	69.	56.7	68.5	69.2	56.2	66.5	68.2	55.2	59.5	64.	55.	57.	60.5	52.7	52.7	53.
7	56.5	67.5	68.	56.2	65.2	68.2	55.5	63.7	67.5	56.	58.5	63.2	56.2	56.7	60.5	53.7	53-5	53.7
8	58.2	76.	73.	58.	72.	73.5	58.	69.5	72.5	58.	61.5	67.	57.	59.	63.2	54.	54.	54.7
9	60.	79.5	74.	59.7	75.2	75.	59.7	73.7	74.2	59.	64.	69.2	59.	61.	65.5	55.2	55.2	56.
10	59.	75.	74.5	58.7	71.5	74.5	59.	69.2	74.	59.7	63.	68.	59.7	60.7	64.7	66.5	56.5	56.7
11	57.2	73.	71.	58.	72.	72.5	58.	70.	72.5	59.	62.7	68.5	59.	60.5	65.2	57.	56.5	57.
12	53.5	72.2	68.5	53.7	69.7	69.2	54.2	67.5	69.	56.2	60.2	65.	57.2	58.5	62.5	56.7	56.2	56.5
13	53.	68.2	66.	54.	67.7	67.5	54.	65.7	67.7	55.	59.7	64.7	56.	58.	62.2	56.	55.5	56.
14	50.5	71.5	71.	51.	68.2	71.2	51.2	65.5	70.5	53.	58.2	65.2	54.5	56.5	62.	55.5	55.	55.5
15	52.2	73.5	73.5	52.7	70.2	73.5	53.	67.2	72.5	54.2	59.2	66.5	55.5	58.7	63.2	55.5	55.5	55.7
16	55.5	76.5	74.	55.5	73.7	74.5	55.7	71.	74.2	56.5	62.	68.	57.2	59.5	65.2	56.2	56.	56.7
17	60.	75.	74.2	59.2	74.	75.	59.2	71.2	74.2	59.	63.5	69.5	59.5	61.5	66.	57.5	57.2	58.
18	59.2	77.	72.5	59.2	74.7	73.5	59 7	72.2	72.2	60.5	64.5	69.	60.5	62.2	66.	58.	58.	58.5
19	56.5	73.	70.5	56.	70.5	71.5	56.	68.5	71.	58.	62.	67.5	59.	60.5	65.	58.2	58,	58.
20	58.	79.	77.5	57.	75.7	78.	57.2	72.7	77.2	58.2	63.5	71.5	59.	61.5	67.5	58.5	.58.	58.7
21	63.7	82.7	79.7	62.2	80.2	80.5	61.5	77.	80.	61.5	67.2	74.5	62.	64.5	70.2	59.5	59.5	60.
22	63.5	80.7	77.5	62.5	77.5	77.5	62.5	75.2	77.2	63.	67.5	72.5	63 2	65.2	69.5	60.7	60.2	61.
23	65.5	81.7	75.7	64.5	79.	76.2	64.5	76.7	76.2	64.5	68.5	72.7	64.5	66.2	69.7	61.2	61.	61.5
24	67.	80.7	68.2	66.	78.	70.	66.	75.7	70.7	65.5	69.	71.	65.	66.7	69.	61.5	61.5	61.5
25	64.	78.	70.5	62.5	77.	71.7	62.5	74.5	72.	62.2	67.5	70.2	62.7	65.2	67.7	61.2	61.	61.
26	60.	72.5	62.7	59.5	71.	64.	59.5	68.5	64.5	60.5	64.	65.	61.5	62.7	64.	61.	60.5	60.5
27	55.5	61.7	63.	55.5	60.5	63.	56.	60.2	63.	57.5	58.7	62.5	58.7	59.	60.7	59.7	59.	58.7
28	54.	56.2	56.5	54.2	56.5	56.5	54.7	56.5	57.	56.5	56.5	57.	57.5	57.	57.2	58.	58.	57.5
29	55.2	77.7	71.2	54.	74.5	72.2	53.	70.	72.5	53.	61.	68.2	53.3	58 2	65.	56.5	56.7	57.5
30	57.2	76.5	74.2	56.5	75.	75.	56.	71.5	75.	57.	63.	70.5	58.2	61.	66.7	58.5	58.2	59.
31	60.	75.7	72.	60.	74.	73.2	60.	71.7	74.	60.5	65.	70.5	61.2	63.	67.2	59.7	59.5	60.

READING OF SOIL THERMOMETERS — (*Continued*).

JUNE, 1887.	1 INCH.			2 INCHES.			3 INCHES.			6 INCHES.			9 INCHES.			18 INCHES.		
	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.
1	57.2	65.	67.	58.	63.5	67.	59.	63.	67.	61.	60.7	64.5	61.5	60.7	63.	60.	59.5	59.5
2	63.2	64.7	69.2	62.5	64.	69.7	62.2	63.7	69.2	61.2	62.2	65.2	61.2	61.5	64.	59.5	59.2	59.5
3	59.	71.	70.	58.5	68.7	70.2	59.	67.5	70.2	59.5	63.	68.	60.	61.5	65.5	59.5	59.2	60.
4	63.2	80.2	76.2	62.	78.2	76.4	61.2	74.	76.5	60.5	66.	72.	61.2	63.7	69.7	60.2	60.	61.
5	63.2	76.	71.5	62.5	73.	71.5	62.7	71.7	71.2	63.2	66.	69.2	64.	64.7	67.2	62.	62.	61.7
6	63.	67.	66.	63.	66.	66.	63.	65.5	66.	63.2	63.7	65.	63.5	63.2	64.2	61.7	61.5	61.5
7	63.7	79.	75.5	62.2	76.	75.	61.2	73.2	74.	60.5	65.2	70.	61.2	63.5	67.5	60.7	60.5	62.
8	66.2	78.5	79.	65.2	76.	79.5	65.	73.5	79.5	64.5	67.	74.2	64.5	65.5	70.5	62.	62.	62.5
9	68.	67.7	71.2	67.2	67.7	71.5	67.	67.7	71.5	66.2	66.7	67.2	66.2	66.2	67.	63.2	63.	63.2
10	61.2	84.2	77.2	60.5	82.	79.2	60.5	78.	78.5	61.	68.	74.5	62.2	65.5	71.	62.2	62.2	62.7
11	63.5	84.	77.7	62.5	81.2	79.	60.5	77.5	79.5	62.5	68.5	75.7	63.5	66.	72.	63.	62.7	63.2
12	64.5	86.7	79.7	63.5	84.5	81.	62.5	80.2	81.2	63.2	69.7	77.2	64.5	67.	73.5	63.5	63.5	64.
13	66.5	88.5	79.	65.2	86.5	79.2	64.	82.2	80.5	65.	71.5	77.	65.7	68.7	73.5	64.5	64.2	65.
14	69.5	89.5	80.2	68.	86.7	82.	66.7	82.	82.5	66.5	72.5	78.7	67.	69.5	75.	65.	64.7	65.5
15	64.	83.5	82.7	63.5	80.7	83.2	63.	77.5	83.2	64.5	69.5	78.	66.	67.7	74.2	65.5	65.	65.5
16	70.5	85.7	83.7	69.5	82.5	84.2	68.7	80.5	84.	68.2	83.2	79.	68.5	70.7	75.7	66.	65.7	65.7
17	68.2	72.2	70.	69.5	71.2	70.5	69.7	70.7	70.5	70.5	69.5	70.2	70.5	69.2	69.2	66.7	66.5	66.
18	61.2	77.5	69.7	61.	75.	70.5	61.2	73.7	71.	62.7	67.2	70.5	63.7	65.7	69.	64.5	64.2	64.5
19	64.	68.5	72.	63.	67.5	72.	62.2	67.	71.5	63.	65.5	69.2	64.	65.	67.7	64.	63.5	64.
20	65.	83.5	78.2	64.2	82.2	78.7	64.	78.2	79.	64.	69.5	75.5	64.5	67.2	72.5	64.	64.	65.
21	70.2	81.5	75.	69.	79.5	75.2	68.	77.5	75.	67.	70.5	73.2	67.5	69.	71.5	66.5	65.5	65.7
22	65.5	74.5	72.5	65.	73.	72.2	65.2	71.	72.	66.5	67.5	70.	67.	67.	68.7	65.7	65.5	65.5
23	63.5	75.	71.	63.2	73.	71.5	62.2	72.5	72.	63.2	67.5	70.7	64.5	66.5	69.2	65.	64.5	65.
24	62.5	71.	65.2	62.	71.	65.7	62.	69.2	66.	63.	65.5	66.5	64.2	65.	66.5	64.7	64.2	64.2
25	59.5	75.5	73.5	58.7	75.5	73.7	57.7	72.5	73.2	58.7	65.	70.5	60.7	63.7	68.2	63.2	63.	63.5
26	61.	80.5	76.2	61.2	78.5	77.7	60.5	75.2	78.	62.	67.5	74.5	63.5	66.	71.5	64.	63.7	64.5
27	61.	82.7	78.2	61.5	80.7	79.5	61.5	77.5	79.5	63.	68.7	75.7	64.7	67.	72.5	64.	64.5	65.
28	63.	88.	81.	63.5	85.	81.7	62.4	80.7	81.7	63.5	70.5	77.7	65.	68.2	74.5	65.2	65.2	65.7
29	67.2	90.7	86.	67.	88.5	86.7	65.7	84.	86.7	60.5	73.5	81.	67.5	70.7	77.	66.2	66.5	67.2
30	70.5	93.	87.	70.5	90.	87.5	69.2	86.	87.7	69.7	75.7	82.5	70.5	73.	79.7	68.	68.2	69.

READING OF SOIL THERMOMETERS — (*Continued*).

JULY, 1887.	1 INCH.			2 INCHES.			3 INCHES.			6 INCHES.			9 INCHES.			18 INCHES.		
	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.
1	71.5	92.	89.2	71.2	89.5	89.5	71.	86.7	89.5	71.7	77.	84.	72.2	74.2	80.	68.5	69.	70.
2	78.2	96.5	90.7	77.	92.5	90.7	76.	90.	90.5	75.	81.	85.5	74.5	77.5	81.7	70.5	70.5	71.5
3	77.5	99.7	89.7	76.7	95.5	90.	76.	91.	89.7	75.	81.	85.5	75.2	78.	82.	71.7	71.7	72.2
4	77.	95.	89.5	76.5	91.2	89.5	75.7	88.2	89.5	75.	79.5	85.5	75.2	77.	83.	72.2	72.	72.5
5	73.5	92.	85.5	73.5	87.7	85.5	73.5	85.2	85.	74.5	77.7	81.7	75.	76.	79.	72.2	72.	72.
6	73.2	85.	78.	72.7	84.2	79.	72.5	82.5	80.	72.5	77.5	79.	73.2	75.5	77.2	71.5	71.	71.2
7	70.2	90.5	87.2	70.2	88.5	88.2	69.2	85.5	88.5	69.5	76.	83.5	70.5	74.	80.	70.5	70.2	71.
8	75.2	96.2	90.2	75.	94.2	91.7	74.	90.2	91.7	73.5	80.	86.7	73.7	77.	82.7	71.5	71.5	72.5
9	75.2	86.7	75.2	74.5	85.5	75.5	74.2	84.7	76.	75.	79.5	76.	75.2	77.	76.	72.5	72.5	72.
10	67.7	69.5	66.7	68.	70.	67.7	68.5	70.2	68.2	60.	70.5	69.5	70.7	70.5	70.2	70.5	70.	69.5
11	63.	80.	79.5	63.2	78.5	80.5	62.5	76.5	81.5	64.2	69.5	77.5	66.	68.5	74.5	68.	67.5	68.2
12	68.	90.	87.	67.	89.	88.	65.	85.	88.2	66.	74.5	83.2	67.5	72.	79.	67.	68.5	69,2
13	73.7	91.5	89.	73.2	90.5	90.	73.2	87.	90.2	73.5	77.7	85.7	73.5	75.5	81.2	70.7	70.7	71.5
14	72.	88.7	83.2	72.7	87.5	85.	72.	85.	85.5	73.	77.5	83.	73.7	75.5	80.	72.	71.5	72.
15	70.2	75.5	76.5	70.	74.7	76.7	70.2	74.7	76.7	71.5	73.5	74.5	72.5	72.7	73.5	71.5	71.	70.7
16	92.7	95.5	85.2	71.2	91.	85.2	70.5	88.	85.2	70.	77.7	82.	70.5	74.5	79.5	70.	70.	71.
17	73.5	78.2	82.2	73.5	77.	82.7	73.7	76.	82.7	74.	73.7	79.5	74.	73.5	77.2	71.5	71.2	71.2
18	72.	75.2	74.	71.7	74.	74.5	72.	73.5	74.7	72.5	72.2	73.7	72.7	72.5	73.2	71.2	71.	70.7
19	67.5	84.7	82.5	66.7	82.7	82.5	66.7	80.2	83.2	68.	73.5	79.5	69.2	72.	76.7	70.	69.7	70.2
20	69.2	85.5	82.	69.5	84.	83.	69.5	82.	83.5	70.7	75.	81.	71.5	73.5	78.	70.7	70.5	71.
21	71.5	85.7	74.	71.5	83.	76.	72.	81.2	77.	73.	74.5	76.	73.2	73.5	78.5	71.2	71.	71.
22	72.7	80.2	74.5	72.	79.	74.5	71.5	78.	75.	71.2	73.7	74.5	71.5	73.	74.	71.	70.7	71.
23	69.2	81.2	77.	69.2	79.7	77.7	69.5	78.5	78.5	70.5	73.2	77.5	71.	72.2	75.7	70.7	70.5	70.7
24	67.5	82.2	81.7	67.2	80.5	83.5	67.	79.2	84.5	68.5	73.	80.7	70.	71.7	77.5	70.7	70.5	71.
25	72.	75.5	75.	71.7	75.7	75.	72.	75.7	75.	72.5	74.5	74.	73.	73.5	73.7	71.5	71.5	71.5
26	71.	80.7	81.	70.5	80.	81.2	70.5	78.2	81.2	71.	73.2	78.5	71.5	72.5	76.7	71.	71.	71.2
27	68.	85.	83.	68.	82.5	82.5	67.5	80.5	82.2	69.5	74.5	79.2	71.	73.	77.	71.5	71.2	71.7
28	70.	86.	85.5	69.5	84.2	86.2	69.5	82.5	86.2	70.5	75.5	82.	72.	73.7	78.5	72.	71.7	72.
29	72.	83.5	34.	72.5	81.	84.5	73.	79.5	84.2	73.7	74.5	80.5	74.	74.	77.7	72.5	72.5	72.5
30	71.	88.7	89.7	70.	85.2	89.5	69.5	83.5	89.	70.5	76.7	83.5	71.5	74.	79.7	72.	72.	72.5
31	75.	91.7	87.5	75,	88.	89.	75.	86.2	89.	75.2	79.2	85.5	75.5	77.	81.7	73.5	73.5	73.7

READING OF SOIL THERMOMETERS—(*Continued*).

AUGUST, 1887.	1 INCH.			2 INCHES.			3 INCHES.			6 INCHES.			9 INCHES.			18 INCHES.		
	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.
1	69.	84.	73.2	67.7	80.5	74.	68.	79.7	74.2	69.	74.5	74.	69.7	71.5	73.	70.	69.5	69.5
2	67.5	76.5	72.	67.	73.7	74.7	67.2	73.5	75.2	68.5	71.	75.	69.2	69.7	73.	69.2	69.	69.
3	57.	70.	68.	58.	67.5	70.	59.	67.2	70.	62.	64.7	69.5	51.5	64.5	68.	68.	67.	67.
4	61.	75.2	74.5	59.2	71.7	75.5	59.7	70.7	75.	61.2	66.5	72.2	63.	65.	69.2	66.	65.5	66.
5	61.5	77.5	69.2	60.5	74.5	70.2	61.	73.	70.	62.5	68.5	69.5	64.2	66.	68.	66.	65.5	66.
6	59.2	78.7	77.	58.	73.5	78.5	58.5	72.	78.2	60.	67.	75.2	62.	64.5	71.5	65.2	65.	65.5
7	64.5	82.5	76.	63.2	78.	77.2	63.5	76.5	77.2	64.7	70.5	75.5	65.5	67.5	72.5	66.2	66.	66.5
8	64.	84.5	81.	63.7	79.5	82.2	64.	77.5	82.	65.7	71.5	79.	66.5	68.5	74.7	67.	66.7	67.5
9	66.2	85.5	83.	66.	81.	84.	66.2	79.5	83.5	67.7	73.2	80.2	68.5	70.2	76.	68.	67.7	68.5
10	69.	85.5	83.	68.2	82.	83.5	68.7	80.2	83.	69.5	75.	79.7	70.	71.7	76.2	69.	68.7	69.2
11	71.5	86.2	81.5	71.5	83.2	82.7	71.5	81.7	82.5	72.	76.2	80.7	71.7	73.	77.5	69.7	69.5	70.
12	65.	77.5	74.5	65.6	75.7	77.5	66.2	74.7	77.5	68.5	71.5	76.	69.5	70.	73.5	69.5	69.	69.
13	62.	79.2	72.	62.	76.	73.	62.5	75.2	73.	68.5	70.2	72.5	66.2	68.	71.	68.2	67.7	68.
14	68.	75.7	71.2	67.5	74.	74.	67.5	73.2	74.	68.5	70.	73.5	68.5	68.7	71.7	68.	68.	68.
15	61.	77.	74.7	60.	75.5	78.	60.5	74.	77.7	62.2	68.5	75.7	64.5	66.5	72.2	67.2	66.7	67.
16	61.	71.5	67.	61.5	70.2	67.	62.	69.7	67.	64.	67.5	67.5	65.5	66.2	67.	67.	66.5	66.5
17	61.	65.7	63.7	62.5	65.5	64.5	62.	65.2	64.5	63.5	64.7	65.	64.5	64.5	65.	66.	65.5	65.5
18	58.	72.5	68.5	57.	70.5	70.2	57.7	69.	70.	59.2	65.	69.5	61.2	63.2	67.5	64.7	64.2	64.5
19	57.7	75.5	73.7	57.2	74.2	76.	58.	72.	75.7	59.7	66.5	73.5	61.5	64.	70.	64.5	64.5	65.
20	60.	77.2	74.	60.	75.2	76.	60.5	74.2	76.	62.	68.	74.2	63.5	65.5	70.7	65.5	65.	65.5
21	63.	76.5	74.	63.5	76.	75.2	64.	75.7	76.	65.5	69.9	74.2	66.	67.5	71.5	66.	66.	66.2
22	63.5	75.7	76.2	63.7	74.7	77.7	64.5	74.5	77.7	65.5	69.5	75.5	66.2	67.2	72.	66.5	66.2	66.7
23	65.	74.	74.7	65.5	71.	75.	66.	70.7	75.	67.	68.2	72.7	67.2	67.5	70.2	66.7	66.5	66.5
24	67.	73.5	69.5	67.2	72.	70.2	67.2	71.5	70.	68.	69.	70.	68.	68.	69.	66.	66.7	66.7
25	66.	77.5	73.2	65.5	75.7	74.7	65.5	74.7	74.5	66.	70.2	73.2	66.5	67.7	70.7	66.5	66.5	66.7
26	60.5	77.	78.5	61.	77.7	80.5	61.5	76.5	80.	63.5	69.7	76.7	65.	67.	73.	66.5	66.5	67.
27	63.7	83.	81.5	64.	81.5	83.	64.5	80.	82.5	66.	72.2	79.	67.	69.	75.	67.5	67.2	68.
28	65.7	83.2	81.2	66.	81.7	83.	66.7	80.5	82.7	68.5	73.7	79.7	69.	70.5	75.7	68.2	68.2	68.7
29	67.7	83.5	82.	68.2	81.7	83.5	68.7	81.	83.5	70.	74.5	80.5	70.5	71.7	76.5	69.	69.	69.5
30	71.	81.5	70.2	71.	80.	72.5	71.2	80.	72.5	72.	75.5	74.5	71.5	73.	74.	70.	69.7	70.
31	66.2	71.5	68.	67.	71.	70.	67.2	70.5	70.	69.	69.5	70.7	69.5	69.	70.	69.2	68.7	68.5

Reading of Soil Thermometers — (*Continued*)

SEPTEMBER, 1887.	1 Inch.			2 Inches.			3 Inches.			6 Inches.			9 Inches.			18 Inches.		
	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.
1	56.7	78.	73.5	57.	77.5	76.	58.2	73.5	74.7	61.5	66.	72.	63.2	65.	69.5	65.5	65.	65.5
2	62.2	68.	67.7	62.5	68.	68.	63.	67.7	68.	64.7	65.7	67.5	65.5	65.5	67.	65.5	65.5	65.5
3	57.7	69.7	69.2	58.2	69.2	70.7	59.2	68.	70.7	61.5	64.	69.5	63.5	64.	67.5	65.	65.	65.
4	53.5	76.7	74.5	54.	76.7	76.	55.	73.5	75.5	58.5	64.5	72.2	61.	63.5	69.2	64.5	64.5	64.5
5	58.	78.7	77.5	58.	79.	78.5	59.	75.5	77.5	61.2	66.2	73.5	63.	65.	70.5	65.	64.5	65.
6	61.2	66.5	71.2	61.2	66.5	71.2	62.	66.	70.5	63.5	65.	68.	64.5	64.7	67.	65.5	65.	65.
7	66.7	81.	73.	66.5	80.5	75.	66.5	78.2	75.7	66.	70.	74.2	66.2	68.2	72.	65.2	65.7	66.2
8	58.7	72.2	70.	59.5	71.7	71.5	60.5	70.2	71.5	63.	65.	70.5	64.5	65.	68.7	66.	65.5	65.5
9	54.	67.7	64.	54.2	66.2	64.5	55.5	65.	64.7	59.5	62.5	64.5	61.5	62.5	64.5	64.7	64.	64.
10	58.	57.7	57.	58.5	58.2	57.7	59.5	59.	58.5	61.	60.5	60.	62.2	61.5	61.2	63.5	63.2	63.
11	46.5	66.7	61.	47.2	64.5	61.2	48.5	62.	61.5	53.	57.	61.5	56.	57.5	61.	61.7	61.	61.2
12	57.2	65.7	64.5	57.5	63.7	64.5	57.5	62.2	63.	58.	59.7	62.	59.	59.7	61.7	61.	61.2	61.5
13	61.7	70.5	70.5	61.5	69.	70.5	61.7	67.	69.5	61.5	63.	67.2	61.7	62.5	65.5	62.	62.	62.5
14	65.	72.7	67.5	65.2	71.5	69.2	65.2	70.	69.7	65.	66.2	69.5	65.	65.5	68.2	63.2	64.	64.2
15	56.7	73.2	62.2	56.7	72.	64.5	57.5	70.	65.7	60.	63.5	66.5	61.7	63.	66.	63.7	63.5	63.5
16	51.	61.5	60.	51.2	62.7	62.2	52.5	61.7	63.	56.5	58.5	63.	59.	59.5	62.2	62.7	62.2	62.
17	45.7	66.2	63.2	46.2	67.	65.2	48.	64.5	65.2	52.5	57.2	61.	55.5	57.5	62.	61.	60.5	60.5
18	49.	67.7	67.	49.	67.5	68.2	50.5	65.7	68.2	54.	58.5	65.7	56.	58.	63.2	60.2	60.	60.2
19	55.2	73.5	68.	55.2	73.	70.	56.2	71.	70.2	58.	62.7	68.5	59.5	61.5	66.	60.7	61.	61.5
20	52.	67.7	64.5	53.	66.	66.	54.2	64.2	66.	57.5	59.5	65.	59.5	59.5	63.2	61.5	61.2	61.
21	53.2	69.5	70.	52.7	68.7	70.	53.7	67.	69.7	56.	61.2	66.5	57.7	59.5	64.5	61.	60.5	61.
22	57.5	63.2	58.5	58.2	62.7	59.7	59.2	62.5	60.5	61.5	61.5	61.5	62.	61.7	62.	62.	61.7	61.7
23	51.	53.7	50.5	51.5	53.2	52.	52.7	53.5	53.2	56.	55.	55.5	57.7	56.5	56.7	60.5	60.	59.5
24	47.5	49.5	49.7	47.7	49.	50.5	48.2	49.2	51.	51.	51.	52.5	53.2	53.	53.7	58.2	57.7	57.5
25	48.	54.	50.5	46.2	53.5	51.7	47.	53.	52.5	50.	52.	53.7	52.	52.7	54.5	56.	56.5	56.2
26	43.	60.2	56.	43.2	59.2	57.7	44.5	58.	58.7	48.	52.	58.	50.5	52.	56.6	55.7	56.7	56.
27	45.5	62.	59.	45.7	59.2	59.5	46.5	57.	59.6	49.5	52.2	57.7	51.5	52.5	56.7	55.7	55.5	55.7
28	54.	69.	61.2	54.	68.2	62.5	54.5	66.	63.	55.	58.5	62.5	55.5	57.	60.7	56.5	56.7	57.2
29	57.2	63.7	62.	57.	62.2	62.2	57.2	61.2	62.	57.5	58.5	61.	57.7	58.2	60.	58.	58.	58.2
30	59.5	70.	67.5	59.2	68.2	68.	59.2	67.	68.	59.	62.	65.5	59.	60.5	63.5	58.5	58.7	59.5

READING OF SOIL THERMOMETERS — *(Concluded)*.

OCTOBER, 1887.	1 INCH.			2 INCHES.			3 INCHES.			6 INCHES.			9 INCHES.			18 INCHES.		
	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.
1	60.	66.5	61.5	60.	66.	62.5	60.5	65.	63.	60.5	62.	63.2	61.	61.5	63.	60.	60.	60.5
2	56.	61.	59.2	55.7	61.2	60.5	56.	60.8	61.	57.5	58.8	61.2	58.2	58.7	60.5	59.7	59.7	60.7
3	53.	63.	54.5	52.5	62.2	55.	53.	60.5	56.2	54.5	56.	58.	56.5	56.5	58.5	59.	58.5	59.7
4	49.5	50.2	49.	50.	50.5	49.5	50.5	51.	50.5	53.	52.5	52.5	54.5	54.	54.	57.	57.	57.
5	49.5	51.	52.	49.	51.	52.5	50.	51.5	53.	51.	52.	53.5	52.5	53.	54.	56.	56.	56.
6	46.	53.	52.5	46.2	53.	52.2	47.	53.	53.	50.	52.	53.5	52.	52.5	53.7	55.5	55.5	55.
7	50.5	57.7	57.	50.2	57.	57.7	50.7	56.2	58.	51.5	54.5	57.	53.	54.2	56.5	55.5	55.2	55.7
8	51.	67.	64.5	51.	66.5	65.2	51.2	64.5	65.5	53.	57.5	63.5	54.	56.	61.	56.	56.	56.7
9	58.	65.	62.	58.	64.3	63.	58.	63.7	63.	58.5	60.5	61.5	58.5	59.7	60.5	58.	58.	59.
10	60.7	65.2	55.5	60.5	65.	57.	60.7	64.5	58.	60.	62.	60.	60.	61.	60.5	59.	59.	59.
11	48.5	52.	49.7	49.	52.	51.	50.	52.5	52.	53.5	53.	54.5	55.5	54.7	55.5	58.	52.5	57.2
12	40.7	46.5	44.5	41.	46.7	45.5	42.5	47.	46.7	47.	48.	48.	50.	50.	50.5	56.	55.2	54.5
13	43.	50.	47.	42.7	51.5	47.7	43.7	51.2	49.	46.	48.5	50.2	48.	49.	50.7	48.7	53.5	53.7
14	39.	46.5	44.5	39.5	46.7	43.2	41.	46.7	45.	45.	47.5	48.	47.7	48.5	49.	52.7	52.5	51.5
15	36.2	50.7	46.5	36.5	53.2	49.2	38.	52.2	50.7	42.	46.5	52.	45.	47.	51.	51.2	51.5	51.5
16	37.	53.2	49.	37.2	53.5	50.5	39.	51.9	51.5	42.	46.5	51.5	45.5	46.8	50.	51.	50.7	50.7
17	42.2	59.	55.5	42.5	58.7	57.	43.2	56.5	57.	45.5	50.	55.	47.5	49.2	53.2	51.2	51.2	51.5
18	49.7	52.2	48.	51.	52.2	50.	51.	52.2	51.	52.2	52.	52.2	52.5	52.4	52.5	53.	53.	52.7
19	43.	59.2	51.5	42.5	59.5	53.7	44.5	57.7	55.	47.	51.5	55.5	49.2	51.	54.	52.5	52.7	53.5
20	41.	55.7	52.	41.	55.	53.	42.2	53.5	53.5	46.	49.	52.7	48.2	49.2	52.5	52.2	52.	52.
21	47.	47.5	42.	47.	48.5	44.	48.	48.7	46.	49.7	49.5	49.5	51.	50.5	50.	52.5	52.5	53.
22	35.7	40.	38.	36.2	41.5	37.5	37.7	42.5	40.	42.	43.5	43.	45.	45.	45.	51.	50.2	50.
23	34.	39.2	40.	33.5	38.5	39.5	34.7	38.8	40.	37.5	39.7	40.5	40.7	41.	41.2	48.5	48.5	47.7
24	43.2	43.	41.	42.5	43.2	41.5	43.2	44.	42.2	44.	44.5	44.	46.	45.2	45.	48.	48.	48.
25	36.5	44.	38.	36.	43.7	39.5	37.2	43.2	41.	40.	42.	43.5	42.5	43.	43.	47.7	47.5	47.5
26	30.	42.5	40.	31.	40.	41.7	32.7	38.5	42.2	36.5	37.	43.	39.7	38.7	42.7	46.5	46.	46.
27	38.5	47.5	45.	38.	46.	45.2	38.	45.	45.5	40.	42.	45.	40.5	42.5	44.7	46.	46.	46.
28	34.2	48.	44.7	34.2	49.	46.2	35.5	48.	47.2	39.	43.	47.5	41.5	43.	46.	46.2	46.2	46.5
29	41.	47.2	41.	40.7	46.2	42.2	41.	45.5	43.2	42.	43.5	45.	43.5	44.	45.	46.7	46.7	46.7
30	33.	35.	33.7	34.	35.3	35.1	35.	35.8	36.2	38.5	38.2	39.5	41.2	40.5	40.7	46.	46.	45.5
31	29.7	44.2	40.5	30.5	44.	42.	31.7	42.2	43.	35.	37.	43.5	38.	38.7	43.	44.5	44.2	44.

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